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POWER

Volume 35, No. 9.
Issued Every Tuesday.
Hill Publishing Company.

NEW YORK, MARCH 5, 1912.

Price, 5 cents.
Outline of Topics, 62.
Index to Advertisers, 51.

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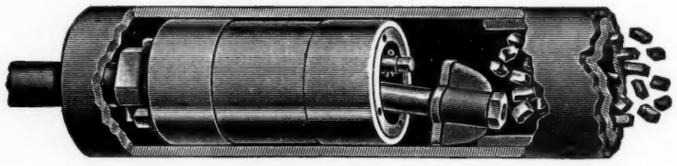

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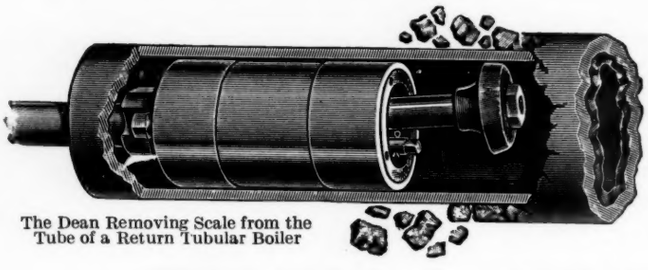

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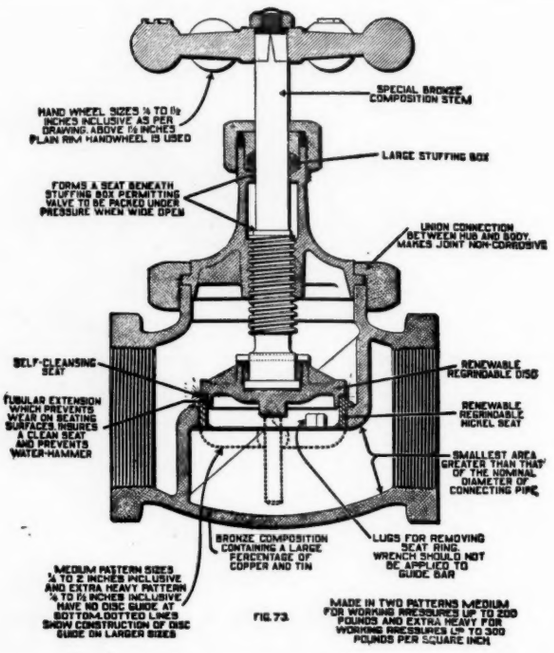
HAND WHEEL SIZES ¼ TO 6 INCHES INCLUSIVE AS PER DRAWING. ABOVE 6 INCHES PLAIN RIM HANDWHEEL IS USED
SPECIAL BRONZE COMPOSITION STEM
LARGE STUFFING BOX
FORMS A SEAT BENEATH STUFFING BOX PERMITTING VALVE TO BE PACKED UNDER PRESSURE WHEN WIDE OPEN
UNION CONNECTION BETWEEN HUB AND BODY MAKES JOINT NON-CORROSIVE
SELF-CLEANSING SEAT
TUBULAR EXTENSION WHICH PREVENTS WEAR ON SEATING SURFACES, INSURES A CLEAN SEAT AND PREVENTS WATER-HAMMER
RENEWABLE REGRINDABLE DISC
RENEWABLE REGRINDABLE NICKEL SEAT
SMALLEST AREA GREATER THAN THAT OF THE NOMINAL DIAMETER OF CONNECTING PIPE
BRONZE COMPOSITION CONTAINING A LARGE PERCENTAGE OF COPPER AND TIN
LUGS FOR REMOVING SEAT RING. WRENCH SHOULD NOT BE APPLIED TO GUIDE BAR
MEDIUM PATTERN SIZES ¼ TO 2 INCHES INCLUSIVE AND EXTRA HEAVY PATTERN ¼ TO 1½ INCHES INCLUSIVE HAVE NO DISC GUIDE AT BOTTOM. DOTTED LINES SHOW CONSTRUCTION OF DISC GUIDE ON LARGER SIZES
FIG. 73.
MADE IN TWO PATTERNS MEDIUM FOR WORKING PRESSURES UP TO 200 POUNDS AND EXTRA HEAVY FOR WORKING PRESSURES UP TO 300 POUNDS PER SQUARE INCH

A valve that has sufficient strength; made of materials best suited for steam use; faultless workmanship; large areas, insuring a free and unobstructed passage of steam, and so designed that all parts can easily be renewed,—must be conceded as one that is perfect, or as nearly so as can be attained.

This being conceded, then the

LUNKENHEIMER "RENEWO" VALVE

can justly be called a valve of perfection, as it embraces all of the above necessary features, and more too, as the seating faces can be reground many times, without removing the valve from its connecting pipe, before it is necessary to renew the seat or disc.

The "Renewo" is a valve of durability, not only because it is possible to renew all parts, but also owing to the scientific design of the seat and disc construction, which mininizes the wear on the seating faces, caused by the great velocity of the steam flowing through the valve,—insures perfectly clean seating faces, and therefore a tight valve,—and eliminates water-hammer.

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1

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Reduces Power Costs

A mechanical cleaner might save you feed-water treatment bills.

But being able to accomplish only temporary results it wastes in fuel many times the amount it saves in treatment cost.

Scale in even a small quantity will waste fuel; and as the quantity increases, the waste increases in proportion.

Mechanical cleaning, furthermore, means shutdowns, delays, night and Sunday work, extra boilers, etc.

It's expensive, every way you consider it.

It's left handed economy that saves in one place and wastes many times the amount in another.

Dearborn Treatment may cost a little more than mechanical cleaners as far as price is concerned, but consider the saving it effects and you'll see why it is the most economical way of tackling the scale problem.

It saves many times its cost every year in coal alone; it saves on repairs; saves worry and trouble; saves night and Sunday work; increases boiler capacity and prolongs boiler life.

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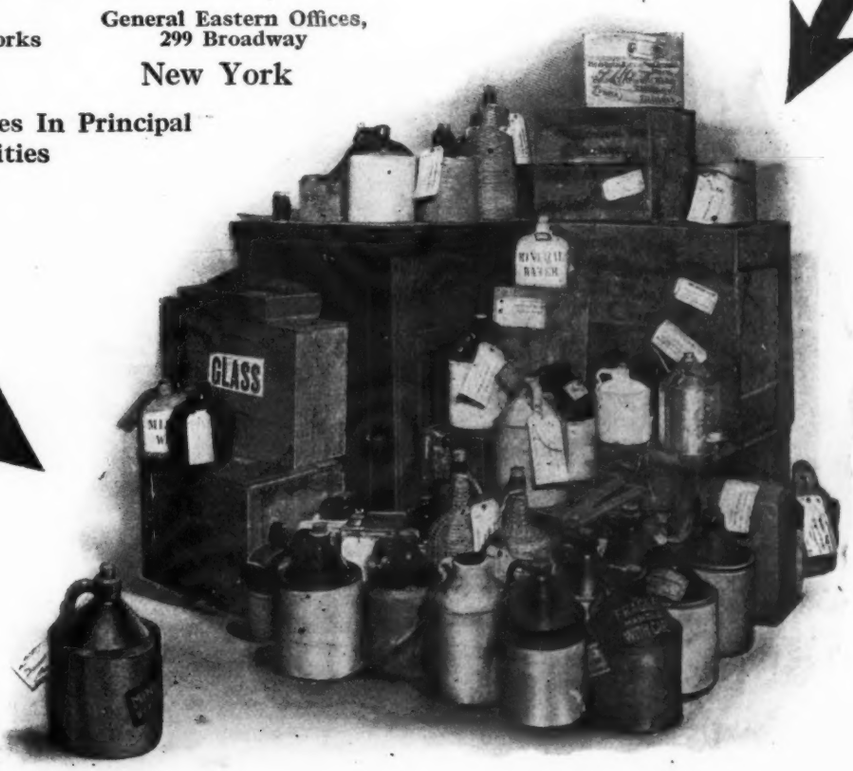

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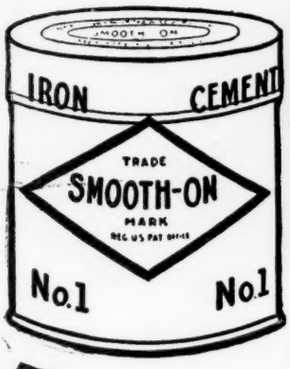

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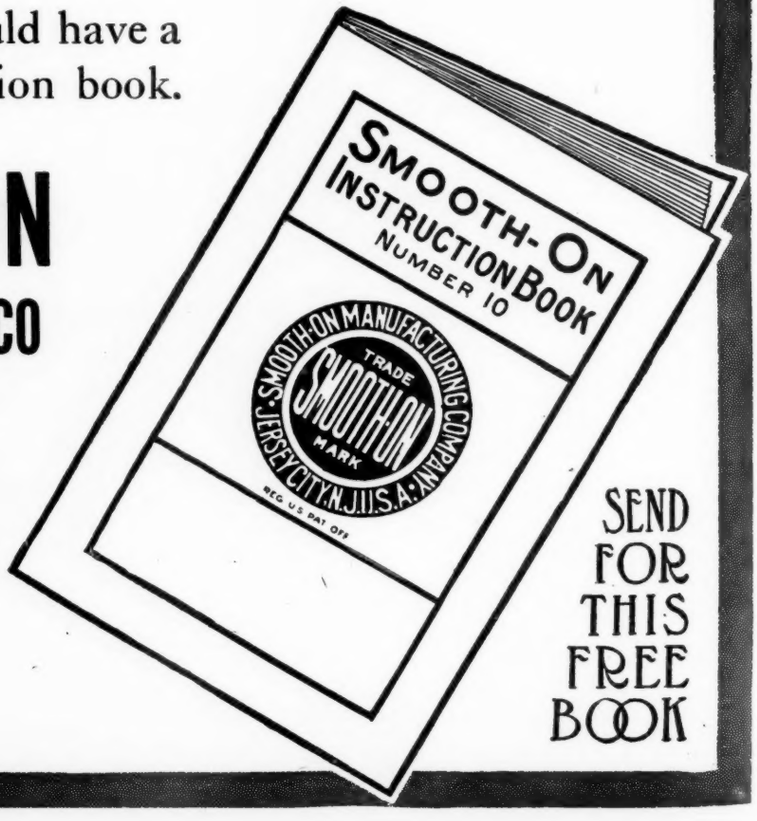

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POWER

Vol. 35 NEW YORK, MARCH 5, 1912 No. 10

THERE are leaks and there are leaks.

A certain engineer once disbelieved this theory. He thought that there were only leaks—the visible or obvious kind. But he is won over now and he is quite convinced that it is possible, yea, even probable that in many plants there are leaks existing which cannot be detected by sight, sound, feel or smell. Serious leaks—leaks that go on day and night, cutting down efficiency and stealthily stealing money out of the office safe, for if it were not for these leaks a lesser amount of money would pay the coal bill and the difference would still repose in the treasury.

Our friend proudly called himself an "old-time engineer, and a thorough one, too, I'll have you understand, sir." He kept his plant in the best appearing condition imaginable. The brightwork on the engines and other machinery was truly bright. Dust, dirt and oil were never allowed to accumulate. One never discovered a steam leak at manhead, joint or valve; as soon as a leak developed it was stopped by putting in new packing or gasket as the case might be, for leaking steam costs money and he was a thorough engineer, you know. In a word, his plant was a model of neatness and order. But, as we have said, he did not think such a thing as an invisible leak could exist.

Steam-engine indicator salesmen had talked to him until they were "blue in the face," but much good it did them! He had successfully run his plant for years without an indicator and he guessed he didn't need one now at his time of life, etc.

Now, our friend had a son who had gone to a so called trades school; it wasn't as advanced as a college, yet it "dug into enough theory to get at the reason why of most things that transpire in an average power plant."

This son was wise beyond his years. He knew his pop was a "leetle" touchy on the score of "book learnin'," as he called it, yet not quite so much as to deprive his son of all the benefits of an education. So the son went slow and carefully felt his way.

One day, as a favor, the father let the son indicate the main engine. The diagrams indicated that a simple change in the valve setting would be beneficial and the son pointed this out to the old man in a diplomatic way. The old man was skeptical, but "game," and the change was made. The result was an appreciable improvement.

Later, the son got a flue-gas apparatus and to "humor" him the father let him make some tests; secretly the old man was gaining great confidence in the young one, but he hated to give in. After the tests the young man suggested that the draft and fires be managed in a different way. When this was done a very marked saving was effected.

Finally, after several similar experiences, the father capitulated and frankly admitted that there was more to successfully operating a steam plant than he had ever suspected.

He realizes now that a plant may look to be in first-class condition and yet be inefficient and waste money in every direction. Do you? If so, what are you doing about it?

Modern German Electrical Plant*

Description of a 10,000-kw. plant on the Finow Canal near Berlin, and the conditions which led to the several distinctive features in design.

*Reprinted from an article by Prof. G. Klingenberg, in die Zeitschrift des Vereines Deutscher Ingenieure.

The Finow Canal joins the Elbe and the Oder Rivers and includes in part of its length the Finow, a little river from which energy is still utilized through hydraulic plants. Along its banks, favored by the nearness of Berlin, lively industries have developed. The small horsepower of the Finow, however, has long since ceased to meet the demand, and steam power has from time to time been added until the Finow is now industrially far more valuable as a carrier of coal barges and of other freight than as a power source.

To supply this industrial district with electricity, the A. G. Märkisches Elektricitätswerk erected on the Finow Canal during 1909 an electrical plant which is herein described.

The preliminaries showed that as prospective consumers there would be principally brick and tile works with about 2000 service hours per year at a load factor of about 100 per cent.; factories with 3000 to 7000 hours and a load factor of from 40 to 70 per cent.; and communities and ranch farms ranging from 150 to 1000 hours with a load factor of about 35 per cent. As a first proposition, 3200 kw. were calculated as the maximum load at any one time; the second proposition was for 5500 and the third for 8800, and the load factor in view of the large power demand was estimated at from 35 to 40 per cent. From this was determined an individual machine size of 3600 kw. capacity with a power factor of 80 per cent., and in accord therewith the building was arranged to accommodate three steam turbines and six boilers having a unit hourly evaporative capacity of 26,400 to 33,000 lb. Of this equipment two turbines and three boilers were at first erected.

General Layout

A building site property was accordingly acquired on the banks of the canal, which was thus available for fuel delivery and for boiler feed and circulating water. A private dock was built to accommodate coal barges of about 200 tons capacity each; and alongside of the dock was located the coal-storage yard. The boiler and turbine rooms are adjacent to this in such a layout that the turbine room fronts on the canal, an arrangement permitting minimum lengths of suction and discharge tunnels. The electrical galleries are in a separate building connected to the turbine room by a covered way.

The coal yard is laid out for the storage of a four months' supply because during cold weather a regular delivery cannot be depended upon. The coal is taken from the boats and piled directly in the yard by means of a motor-operated traveling bridge crane capable of handling 40 tons of coal per hour; this is shown in Fig. 1. For future extension the inner or land-side runway of this bridge is so constructed that a second bridge can be erected to serve the space in front of a second boiler house.

Beneath the coal-storage yard are two reinforced-concrete passageways about 6 ft. square, through which an endless bucket conveyor travels. In the roof of each passageway there is a row of feed funnels through which the coal, stored above, falls to the conveyor. (See Fig. 2.) At the outer end of the storage yard the chain of buckets is conducted transversely above ground from one passageway to the other. Within the boiler house the conveyor is carried on the roof trusses and discharges by means of automatic dumpers which are installed in pairs in each bunker and may be operated from the firing level by means of a handle. The capacity of each bunker does not exceed a two-hour fuel demand per boiler as, in view of the operative reliability of the coal-carrying plant, a storage of coal in the boiler house proper seemed unnecessary. The chief advantage of this arrangement lies in the unusually small weight of the structural work and the absence of special columns.

As a bunker fills it is automatically cut out. Should all the bunkers be full, the buckets return unemptied to dump into a coal pocket on the boiler-house front through the action of a fixed tripper which tips all buckets a second time, and where the falling coal releases a trap which cuts out the operating motor. By alternating the filling of the buckets among different points at the storage yard different kinds of coal can be mixed. The length of the conveyor is about 975 ft.; it is operated by an 8-hp. three-phase motor and has a capacity of 14 tons an hour.

Boilers

The boiler house, Figs. 2 and 3, is designed for six boiler units, each consist-

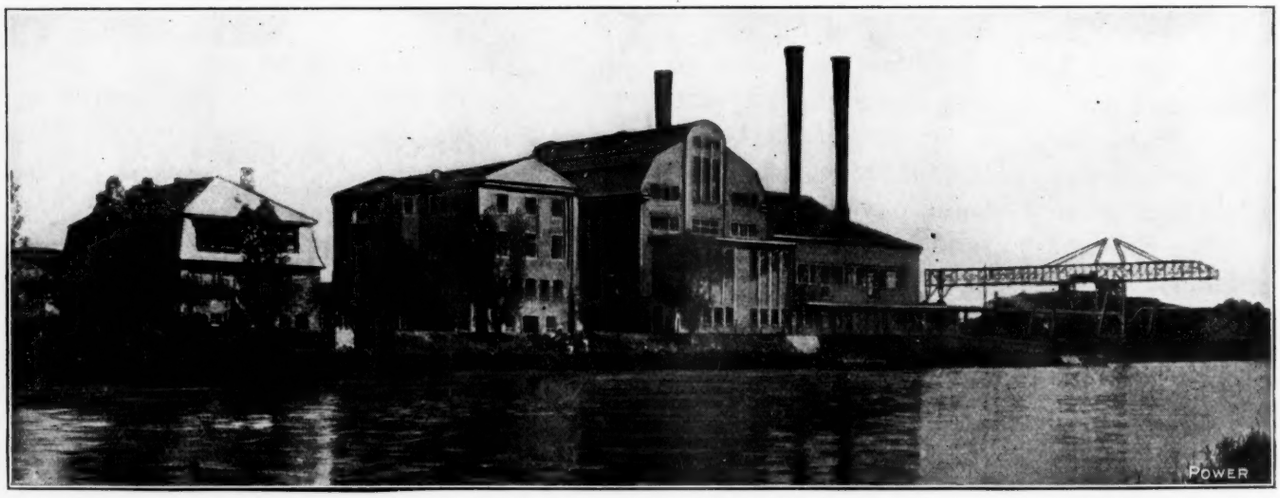


Fig. 1. Plant from River Side

ing of a boiler, an economizer, forced-draft appliances and a stack. The weight of the structural-steel work for the complete boiler house amounts to 213,400 lb., or one pound of steel per pound of water evaporated at maximum load. These unusually low figures were attained in part through the described arrangement of coaling apparatus and in part through a boiler construction suggested by the author and carried out by the Babcock & Wilcox Co., which combined surfaces of a boiler and its economizer are naturally less than with the usual separated arrangement. It is possible also, notwithstanding the relatively low stack height, to operate the boilers with natural draft up to about two-thirds of their maximum capacity, so that the artificial draft need be thrown in only for the heavy loads.

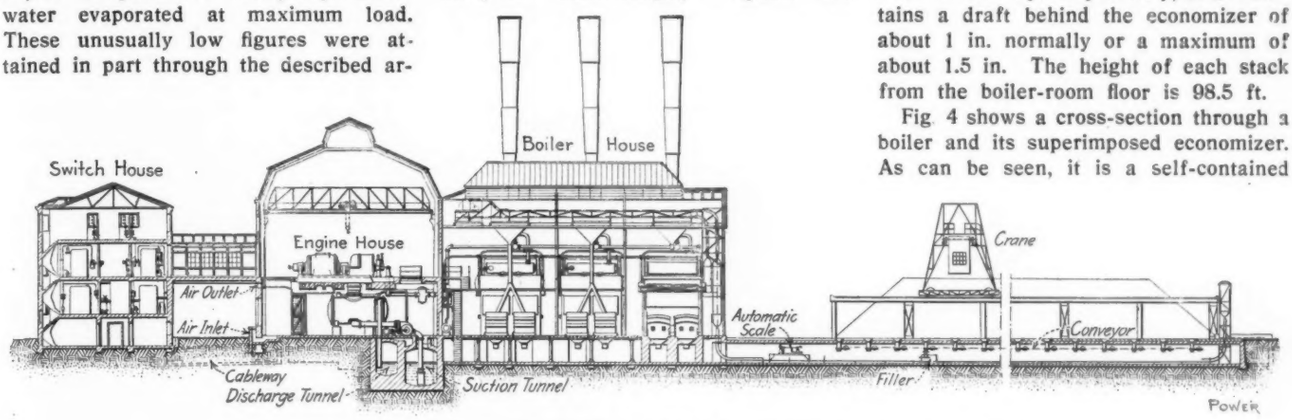


FIG. 2. SECTIONAL ELEVATION THROUGH PLANT, SHOWING COAL-HANDLING APPARATUS

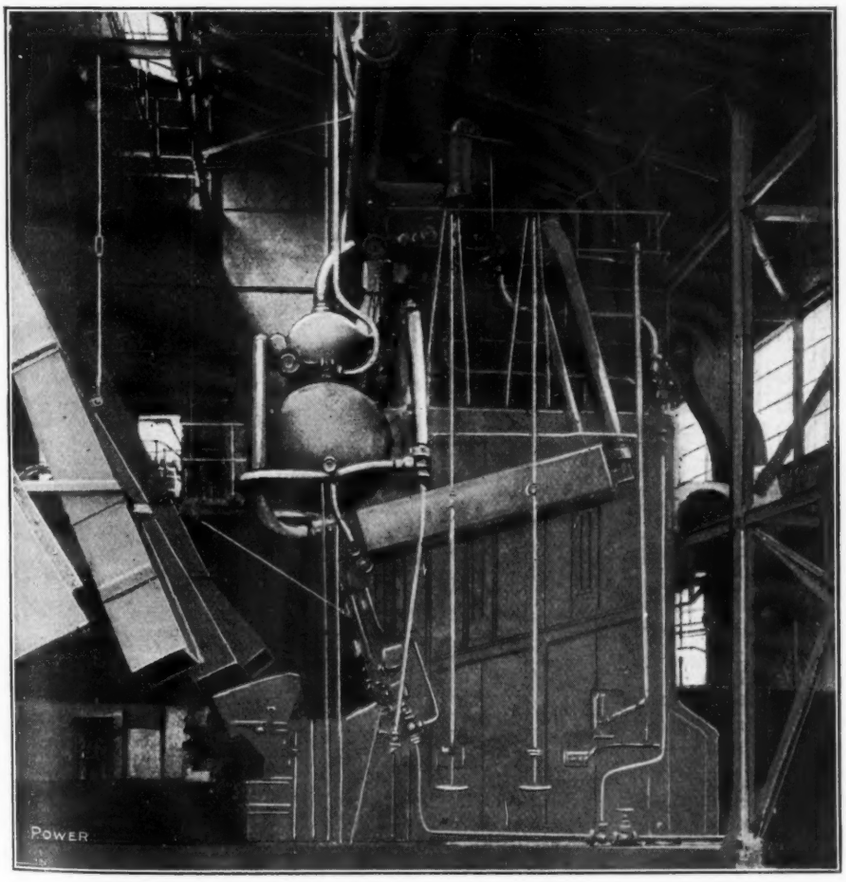


FIG. 3. SIDE ELEVATION OF BOILER

from a thermal standpoint has been well justified.

Aside from the small ground-surface requirement, a further advantage of this construction appears in the small heat loss through radiation and piping, as the

Simplicity of service, the absence of dampers and the fact that the blower is called upon to deliver cold air only and can be set up to be conveniently accessible, are advantages due to the superiority in such cases of forced draft.

The forced draft is furnished by a Sirocco motor-driven blower having a capacity of 1.5 times the air requirement with normal and maximum power needs at 20 and 30 hp. respectively, and maintains a draft behind the economizer of about 1 in. normally or a maximum of about 1.5 in. The height of each stack from the boiler-room floor is 98.5 ft.

Fig. 4 shows a cross-section through a boiler and its superimposed economizer. As can be seen, it is a self-contained group inclosed by a sheet-metal casing preventing the entrance of air. To guard against water being carried over into the superheater, a large receiver drum is placed over the boiler.

The boiler and the economizer of each unit are so designed that the hot gases enter the latter at about 750 deg. F., and

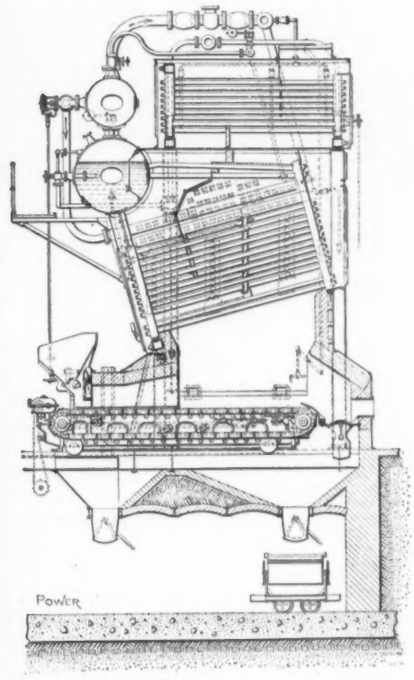


FIG. 4. SECTION THROUGH BOILER AND ECONOMIZER

the feed water is heated to about 250 to 285 deg. The ashes fall through hoppers under the ashpits to the basement from whence they are carted away.

The boilers are automatically fed by turbine-driven multi-stage centrifugal pumps, the speed being governed by a pressure regulator. The exhaust from these turbines is led to coil-type re-

ceivers serving as primary feed-water heaters from which the water flows under pressure to the centrifugal pumps for delivery to the boilers.

Under normal conditions, each boiler unit evaporates 27,700 lb. of water per hour but has a maximum capacity of 34,600 lb. The heating surface per boiler amounts to 4400 sq.ft., each superheater 1450 sq.ft., and each economizer 2260 sq.ft.

Steam Piping

In Fig. 5 is shown the main steam piping. This consists essentially of a main line from each row of boilers leading to a main separator; these separators have a cross-connection from which lead the branches to the main turbines, each branch being provided with its individual separator.

The two main lines are cross-connected in the boiler room, but a true ring header is not thus established as the cross-section is not sufficient for the passage of the total boiler output. Seamless steel piping is used with cast-steel rolled flanges and spherical segment rings; the valves are of cast steel with nickel seats, and all valves may be operated from the boiler-house floor, the main valves having "shut" and "open" indicators. The piping was laid out for a maximum steam velocity of 15,700 ft. per minute.

The nonconducting covering of the steam piping consists of siliceous earth, 2.375 in. thick, the flanges in addition being fitted with cast-iron covers with drip connections.

Water Supply

Water for condensing purposes is taken from a suction tunnel running parallel to the turbine room, and a similarly located discharge tunnel carries it back into the canal. The water circulation for the cooling of the turbine bearings is supplied by small motor-driven centrifugal pumps placed in the basement and in connection with the two tunnels mentioned.

For the boiler feed only small quantities of water need to be added; the water losses are small as the condensate from the feed pumps is free from oil and is fully recovered. As the water from the canal is hard, a purifier is used; from this the water flows to a reservoir into which also are returned the drips from the various separators.

All these centrifugal pumps are equipped with ejectors operated by saturated steam directly from the boiler.

Turbo-Generators

The turbine room, Fig. 6, in its present stage of completion affords space for three turbo-generators each of 3600 kw. with a power factor of 80 per cent. These are designed for steam of a pressure of 185 to 215 lb. gage at a temperature of 570 to 660 deg. F. at the throttle and are provided with nozzle regulation which with small loads permits of a material reduction in the steam consumption.

The condensers, which are of the ordinary contraflo surface type, are each equipped with a rotary circulating and hotwell pump driven by a small steam turbine (see Fig. 7). The exhaust from these turbines is individually led to an intermediate stage of one of the main turbines. The condensate is passed through a water meter provided for each turbine so that it is possible at any time to determine the steam consumption of the turbine.

The generators operate with a pressure of 10,000 volts, maintained constant with Tirrill regulators. Each generator has a switch panel carrying the necessary

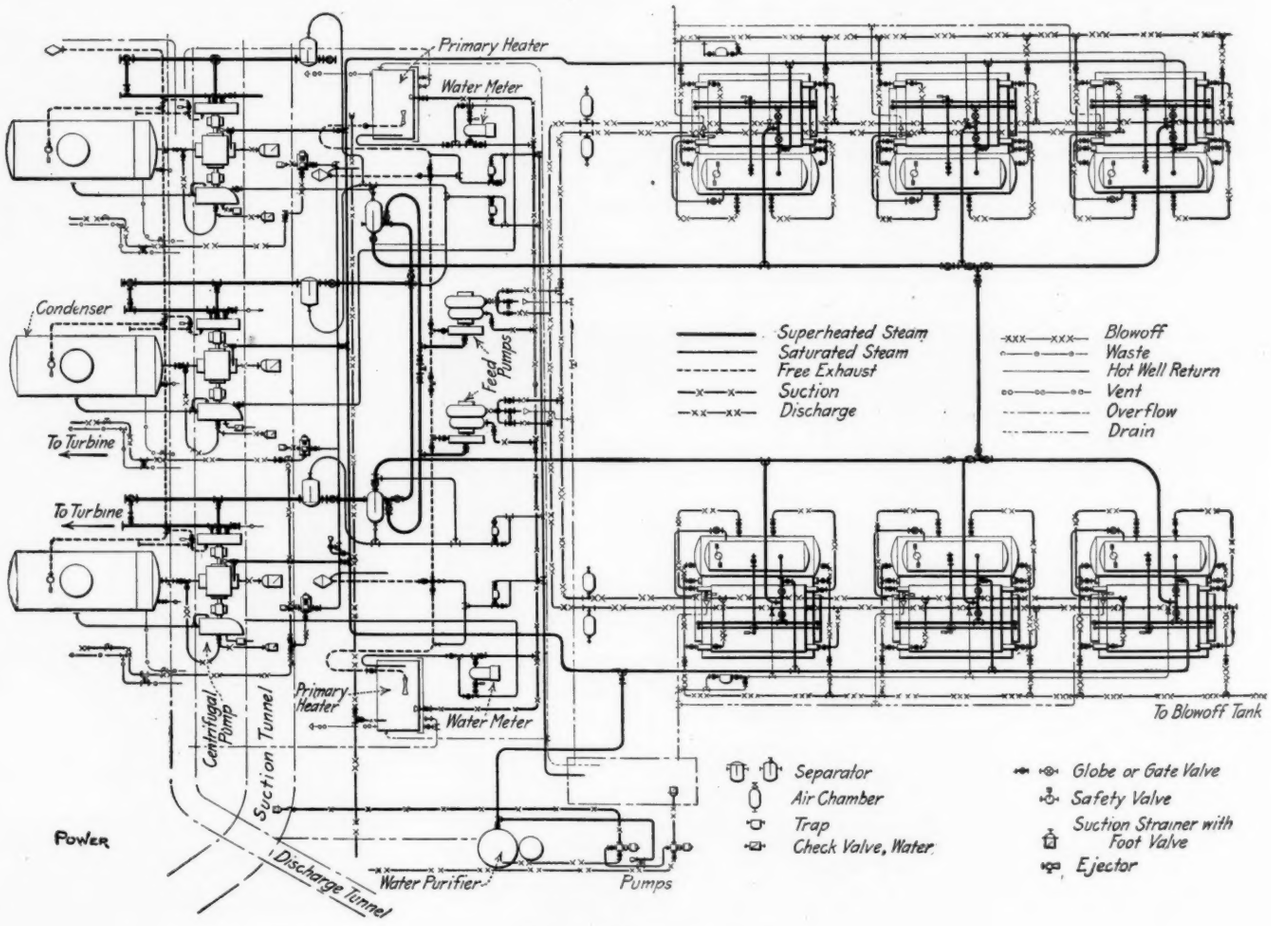


Fig. 5. Piping Layout

meters and in addition signaling apparatus for communication with the switchboard.

Switch Galleries

In providing a separate building for the switch galleries, the cost was but slightly increased (one more wall) and two more light sources were gained. This separate construction also has the advantage of being independent of inner constructive requirements of the engine house and electrical galleries in the matters of heights, column arrangements and roof constructions—advantages of value in later extensions. The often advanced argument that the electrical galleries should be in the closest possible communication with the engine house will not bear investigation; for the distributing installation, except for the voltage control of the generators, belongs rather to the transmission system than to the generators.

The claim that the switchboard attendant should see the machines is equally groundless; on the contrary, it is better that he be removed from the noises of the engine room and left to be entirely guided by the readings of his instruments. There are known cases where sudden machine failures have prompted wrong switch handling. The only necessary intercommunication of the switch galleries and the engine house concerns the cutting in or out of the generating units and their loading, and this simple intelligence is best conveyed by means of signals.

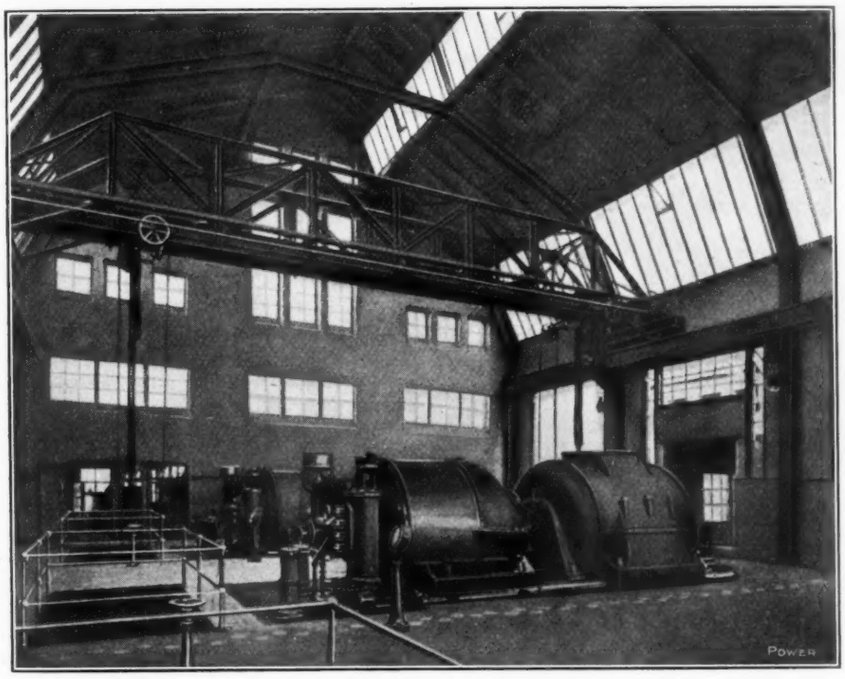


Fig. 6. Turbine Room

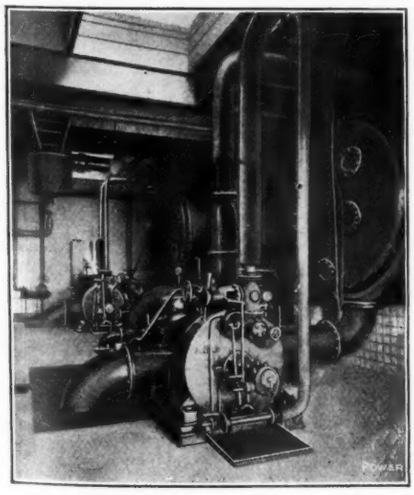


Fig. 7. Condenser Accessories

Corrosion of Condenser Tubes

A recent issue of *Engineering* contains a paper by Arnold Philip upon the corrosion of condenser tubes, the paper having been read before the Institute of Metals on Jan. 17.

Mr. Philip was of the opinion that only about 10 per cent. of the cases were serious, these being localized corrosion or pitting. Accordingly his remarks dealt almost exclusively with such cases as found in tubes of Admiralty composition —namely: copper, 70 per cent.; zinc, 29 per cent., and tin, 1 per cent. Of these cases fully 90 per cent. resulted from known causes which could have been neutralized or overcome by such preventives as bars of zinc, aluminum or iron. The presence of these so called electro-positive metals, however, is not alone sufficient to prevent corrosion of the condenser tubes immersed in the same bath of sea water. It is essential that there shall be a direct circuit between the tubes and the protecting metals and that both shall be immersed in the same electrolyte.

In this connection may be mentioned the practice in the British navy. Zinc and iron were originally used in condensers in which the body was of cast or wrought iron, and the sea water passed outside the tubes, and was therefore at the same time in direct contact with the outside of the metal condenser tubes and the inside of the iron case. Under these circumstances the protection was very complete, and while corrosion of the steel or iron casing took place, the corrosion of the tubes was practically unknown. Steel or zinc protector-slabs and bars have been used attached inside the condenser doors, or on the tube plates themselves, or some of the tubes of the condenser have been replaced by iron or steel, or even zinc, rods; while in some condensers, built about four years ago, the bodies were of metal of a composition closely approximating to that of the tubes, with the doors of iron or steel. More recently condensers have been made with steel bodies.

A peculiarity noted in nearly all the cases investigated by Mr. Philip was that the corrosion occurred along the bottom of the inside of the tubes. This would indicate that the trouble was caused by the contact of particles of carbon or ferric oxide, or other electro-negative solids deposited from the cooling water, and setting up a galvanic action. This action is increased when the condenser is not in use and the tubes remain full of sea water.

If, on the other hand, the condenser is emptied of water when not in use there would be a possible source of danger of corrosion along the bottom inside surface of the tubes, because this portion would be exposed longest to the joint action of salt water and air. It was suggested by Mr. Philip that this cause might be removed by employing vertical or inclined tubes.

The discussion following the presentation of the paper corroborated in general Mr. Philip's opinion, although the question was raised as to whether the presence of gases in the water did not have a decided influence in any corrosive action. It was generally conceded that they would, but no definite information was offered in support of this contention.

A special committee has been appointed by the institute to look into the subject of corrosion and its report will be awaited with interest.

It is this very feeling of "wanting to know" which distinguishes the man who means to succeed from the man who merely hopes that he will do so.

Steam Consumed by Vacuum Cleaner

By J. V. Hunter

Results of a test upon a steam-ejector type of vacuum cleaner, showing the steam consumption at different vacuums and loads with from one to four sweepers attached.

Within the past few years little has been recorded publicly of tests upon any of the systems which have been appearing on the market for the so-called vacuum-cleaning process. For this reason, tests which were conducted a few years ago upon a steam-ejector type of cleaner may be of interest on account of the principles involved and the results obtained as compared with those of other types on the market.

The system of vacuum cleaning has become so well known that little need be said in regard to its principles except that, like all machines, this blower was intended to exhaust air, the inrush of air thus created through suitable cleaning devices, nozzles, etc., being employed to draw dust and dirt out of carpets, upholstery and other household furnishings, the steam ejector which was tested being intended for heavy-duty service in connection with large office buildings, hotels, etc., where the boiler plant could furnish enough live steam for its operation.

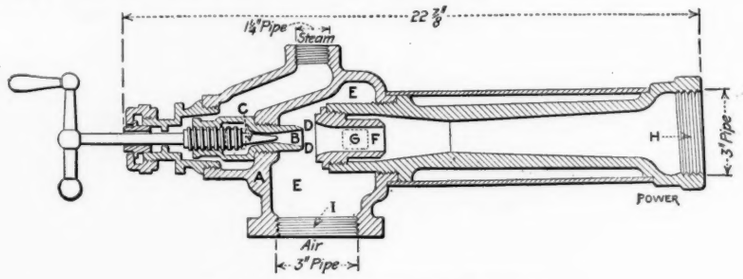


FIG. 1. SECTION THROUGH EJECTOR

HISTORY

The principle involved does not seem to be a new one; Kent's "Mechanical Engineers' Pocketbook" records sizes and tests on steam-air exhausters. Many of these were used in connection with mine ventilation in England between the years 1810 and 1850. The steam exhauster seems to have been inefficient for this service and, though quite popular for a short time after its advent, it did not continue long in service as the furnace ventilation process was less than half as expensive to operate.

It also appears that the reverse principle of this apparatus was used for some years in connection with the production of the necessary air-blast for blast furnaces. In this position it acted as a blower and was capable of producing air pressures up to one-sixth the pressure of the steam supplied for its operation.

In view of the modern developments of the Gayley dry-air blast system—wherein it has been shown that the efficiency of a blast furnace and its output may be considerably increased by refrigerating the air supplied in the blast to remove every particle of moisture, it is not surprising that the steam blower did not continue long in service for this purpose, since the air, being very heavily charged with steam, must have considerably decreased the efficiency of the blast furnace.

A section of the blower under discussion is shown in Fig. 1. Within an outer shell *A* is placed the nozzle *B* through which the steam rushes past the controlling valve *C*. The velocity of the steam carries the surrounding air with it and creates a suction through the openings *D* and a consequent vacuum in the air chamber *E*. This mixture of steam and air rushes through a second nozzle *F* and sucks more air through the openings *G*, leading into the air chamber *E*. The steam, together with the air displaced, passes off through the exhaust pipe *H*.

The amount of air displaced depends on the construction of the chamber and on the quantity and velocity of the steam rushing through it. The opening *I* in the air chamber where the air line is attached, connects the suction line with the rest of the system through a back-pressure check valve (not shown), its duty being to prevent a back-rush of air through the chamber when the steam is shut off. In order to collect all the dust, dirt, etc., picked up by the sweepers and prevent clogging or interference with the operation of the sweeper, this dust is collected in a dry dust-accumulating tank from which the air is sucked by the ejector and to which it is fed by the lines of sweepers.

It must be noted that this sweeper was intended for operation with four lines of hose and is designated as a four-sweeper type. Therefore, to the accumulating tank were connected four valves to each of which was connected a 100-ft. length of hose and mop (sweeper) for cleaning purposes. The sweepers consist of a slotted air-inlet head connected with a suitable hollow handle in which is a valve to close the flow of air when not in use.

VARIATION IN ECONOMY

The economy of vacuum sweeping is not the same at all pressures, but little attention seems to have been given this point by the modern designers of the cheap commercial sweepers. Experiments conducted by Prof. Hallock, of Columbia University, determined the most economical pressures for sweeping to be between 9 and 13 in. of mercury.

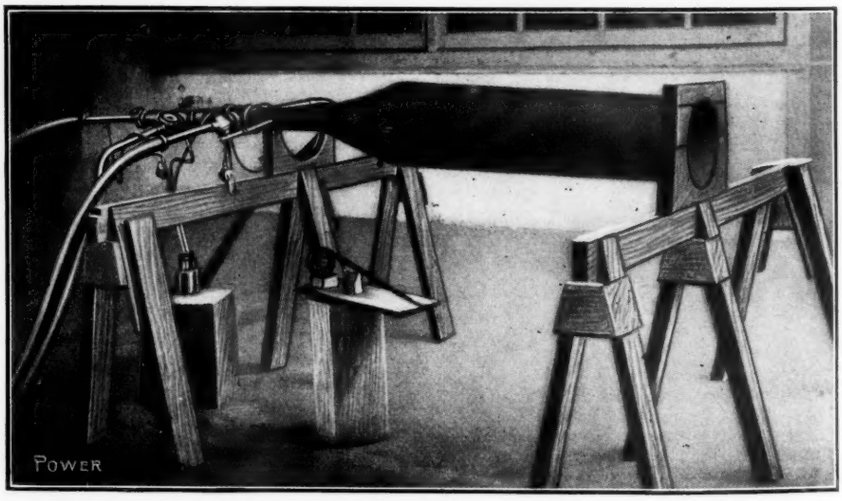


FIG. 2. MEASURING TUBE

TESTS

The ejector subjected to this test was designed to carry a working load of the

four sweepers mentioned with a vacuum pressure of 11 in. To afford steam economy when the full load was not on the ejector, a small plunger-type valve was connected which would decrease the steam supply on the ejector when the pressure rose too high and open it should additional load be put on and the pressure fall. This valve adjustment would not regulate closer than 4 in. of mercury, so it was blocked open and all regulating during the tests done by hand. With a steady load, however, the ejector required little or no regulating.

The tests on this ejector were made with two objects: to determine the quantity of air displaced under ordinary working conditions with a four-sweeper load; and to determine the steam consumption at various steam and vacuum pressures under ordinary working conditions and also for various other loads. The quantity of air displaced per minute was determined with a four-sweeper load for 9, 10, 11, 12 and 13 in. of vacuum in the accumulating tank, although 11 in. was considered the average working pressure carried. When the air displaced by four sweepers at these pressures is known, it would naturally follow that the displacement of a greater or lesser number of sweepers would be in direct proportion to the number of sweepers used.

Steam-consumption tests were made at full load with steam pressures ranging from 80 to 130 lb., with a variation of 10 lb. between each test; also, the tests were conducted at each of the vacuums mentioned. Furthermore, in order to determine the steam consumption at less than full load, tests were conducted with only one, two and three sweepers operating.

In order to have conditions as nearly standard as possible, each sweeper was connected with the ejector by a 100-ft. line of hose, care being taken to see that all lines and joints were air-tight. Moreover, each mop was placed as under working conditions, with the slot against a carpet so that the maximum amount of air would be drawn through the fabric of the carpet. In order to determine the actual vacuum pressure at each of the sweepers, a manometer tube was attached at the junction of each sweeper and hose, the readings being recorded in inches of mercury.

Table 1 shows the vacuum pressures in each sweeper for certain tank pressures and also the average which was determined for all four sweepers.

An attempt was made to equalize the readings by adjusting the position of the sweeper on the carpet, but the inequalities remained. These were probably due to slight differences in the width of the absorbing slots of the sweepers and also to differences which may have existed in the frictional resistances in the different lines of hose.

There were no readily obtainable air meters which would measure so great a quantity of air, and for this reason another method was devised, employing the principle that the velocity of air passing through an opening together with the area of the opening determines the quantity flowing. Therefore, arrangements were made to determine the velocity by means of an anemometer, so the tube for measuring the volume was constructed as shown in Fig. 2. This consisted of a sheet-iron cylinder 9 in. in diameter and 36 in. long, one end being drawn down and fitted to the piping connections, which were duplicates of the valve connections used to attach the hose to the tank. Into the side of this cylinder was fastened a glass U-tube for the purpose of reading the pressure in inches of water at this point. A Biram's portable anemometer was used for determining the air velocity.

TABLE 1. VACUUM, INCHES OF MERCURY

At Tank	Hose No. 1	Hose No. 2	Hose No. 3	Hose No. 4	Average
13	8.54	6.37	9.75	8.88	8.38
12	8.00	6.00	9.12	8.25	7.84
11	7.37	5.43	8.30	7.62	7.13
10	6.75	5.00	7.62	6.94	6.58
9	6.12	4.62	6.88	6.37	5.99
8	5.42	4.12	6.25	5.75	5.38

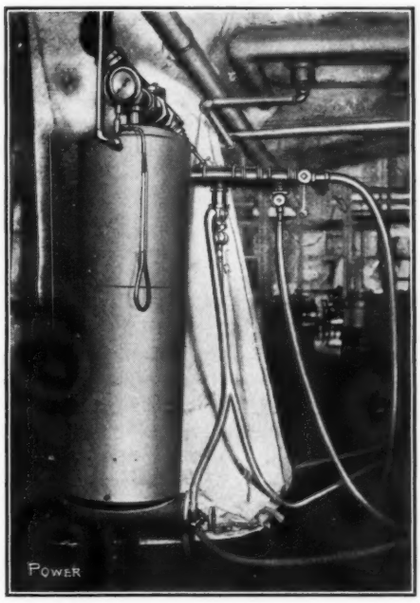


FIG. 3. ACCUMULATING TANK WITH HOSE CONNECTIONS

The anemometer was calibrated before starting the test by noting its speed for each vacuum pressure, the quantity of air passed at these pressures being found by connecting the anemometer with a large air-storage tank from which the air was allowed to escape rapidly and at the same time, by means of the volumes, and pressures could be accurately measured. By means of a controlling valve the air pressures in the anemometer tube, as indicated by the manometer, were kept constant and equal to the results which had been determined for different vacuum pressures when the tube was operating in the reverse direction, the apparatus having been arranged in such a way that the results would be reversible. Correction was determined and made in each test for the reversed position of the anemometer. Under these circumstances, it was found that the four lines of hose were passing quantities of air as shown in Table No. 2.

TABLE 2. AIR DISPLACEMENTS

Vacuum at Tank	Air Displaced, in Cubic Feet per Minute
13	90.1
12	89.1
11	87.8
10	86.4
9	84.2
8	80.9
7	79.1

Had a large enough surface steam condenser been at hand it would have been an easy matter to have condensed the steam, corrected for the humidity of the outcoming air and so determined the steam consumption of the ejector, but owing to the lack of this appliance it was necessary to determine the amount of steam fed to the ejector and to fire a separate boiler for this purpose. In this way it was possible to very accurately determine the steam consumption of the ejector.

Table 3 shows the steam consumption in pounds per hour for the ejector at different steam and vacuum pressures, and also the equivalent boiler horsepower based upon a feed-water temperature of 100 deg. F.

TABLE 3. STEAM CONSUMPTION

Steam Pressure in Boiler, Lb. per Sq. In.	Steam consumed per hour for varying vacuum pressures maintained in ejector				
		13 in.	12 in.	11 in.	10 in.	9 in.
80	Lb.	720	680	630	580	516
	Boiler hp.	24.2	22.7	21.1	19.3	17.2
90	Lb.	700	650	600	540	470
	Boiler hp.	23.4	21.8	20.1	18.1	16.1
100	Lb.	680	620	550	495	439
	Boiler hp.	22.8	20.8	18.5	16.6	16.0
110	Lb.	648	606	532	476	414
	Boiler hp.	21.8	20.3	18.8	16.5	14.3
120	Lb.	654	620	560	490	426
	Boiler hp.	22.0	20.8	18.8	16.5	14.3
130	Lb.	628	598	550	480	416
	Boiler hp.	21.2	20.2	18.5	16.2	14.0

It will be observed that the steam consumption rises very perceptibly at the pressure of 120 lb. Just why this should be, was hard to account for, but it was evidently due to the ejector causing eddies or other losses at this particular pressure. Curiously, the consumption fell again when the pressure rose to 130 lb., but in some cases it did not fall as low as before the increase in pressure. This shows the much greater efficiency of the ejector when working at certain pressures than at others, and would tend

to indicate that under certain exceptional conditions it would pay to run the steam through a throttling valve if the pressure were high, before it was fed to the ejector.

It might be suspected that if this occurred only in one or two instances, it was due to an error in testing; but it will be noted that this rise in steam consumption occurred at all vacuums and all the tests, which were carefully repeated and checked, indicated this increase.

In order to test the relative efficiencies of the ejector with loads of less than four sweepers, tests were made with three, two and with a single sweeper working at the end of a 100-ft. length of hose. Under these circumstances, the tests were made with an average vacuum of 11 in. of mercury and a steam pressure of 100 lb. From the results of these tests the steam consumption may be approximated for any other steam pressure and for a varying number of sweepers by referring to the former steam-consumption tests. The steam consumptions for the different loads are given in Table 4.

TABLE 4. STEAM CONSUMPTION AT VARYING LOADS

Number of Sweepers	Steam Consumption, Pounds per Hour
4	550
3	514
2	480
1	450

In view of the fact that there is so little decrease in the steam consumption to maintain a given vacuum with fewer sweepers working, it is probable that a considerable amount of the steam used went to maintain the vacuum in the ejector cylinder, and possibly if other tests could have been made with varying outlet shells, it would have been found that the efficiency could be materially increased at lighter loads.

In comparing these with other tests which may have been conducted on a pump or cylinder type of vacuum cleaner, due allowance must be made for the fact that all values of air displacement given in these tests are for cubic feet of free air and not for rarefied air, while if a test is conducted on a regular vacuum-pump cylinder, due allowance must be given for the rarefied condition of the air which the pump is handling, so that it really must handle from 20 to 50 per cent. more volume in order to exhaust an equal volume of free air.

New York City has established a fire-prevention bureau, and the Board of Estimate has made an allowance of $200,000 for its maintenance. Included in the bureau are an assistant electrical engineer at $3000; two electrical inspectors at $1800 each, and an assistant chemist at $1800. It is not known whether the appointments will be from civil-service lists.

Engine Foundations

By R. B. Dale

Engine foundations perform two functions; they hold the engine bed rigidly in place and they absorb vibrations. The foundation must, therefore, be heavy and bulky and it must have a substantial and firm bearing in the earth. Concrete is by far the most available and best suited material for this purpose. It is not only a comparatively inexpensive material but it is also exceedingly convenient to handle and to mold into the necessary form. Moreover, with intelligent supervision, the foundation may be built without the use of skilled labor. However, sufficient time must be allowed for the concrete to set before a load is placed on the foundation.

The engine base is held to the foundation by means of anchor bolts. These are mild-steel rods several feet long with a square nut and anchor plate at one end and a hexagon nut at the other. The foundation is usually built and the anchor bolts set in the locations indicated for them on the engine builder's setting plans before the engine has been shipped so that the foundation may be ready to receive it when it arrives. The anchor bolts are hung from a template which is securely fastened to the top of the forms for the concrete, and the anchor plate is completely buried in the concrete. A small wooden box, tapering from the lower end to the upper end, is made to surround the anchor bolt; this allows for a slight adjustment of the bolt so that it will fit into the cored holes provided for it in the engine bed. This precaution is necessary because it is almost impossible and, in any case, too expensive, to set them so that an accurate fit is obtained.

When the engine arrives and after the concrete has properly set, the engine is moved to its foundation where it is set into position. Small iron wedges are driven under the edge of the engine bed until the engine is level, thus leaving a space of ½ in. or more between the engine base and the top of the concrete. The hexagon nuts on the upper ends of the bolts are then tightened up, after which a cement grout is run under the engine base and allowed to set. When the grout has set the wedges are removed and the nuts on the anchor bolts are again tightened as much as possible.

In order that the foundation may perform to the fullest extent its function as an absorber of vibrations, the vertical hole through which the anchor bolt passes is not filled with grout. This allows the bolt to stretch or elongate throughout its entire length whenever subjected to shock. It may be said to act somewhat in the manner of a spring. If the anchor plate is of ample area, no advantage in holding-down force is obtained by grouting the bolt for the whole of its length as the bond between the steel and the concrete is comparatively slight in effect. Any lateral movement of the engine on the foundation is prevented by the force of friction which exists between the engine bed and the top of the foundation. The greater the initial tension in the bolts, the greater is this resisting force. If a slight movement should take place this resisting force would increase enormously because the tension in the bolts would increase as they are stretched to accommodate themselves to the new position. Shearing strains which are liable to occur in the bolt between the top of the foundation and the engine bed, if it is completely bedded in the grout, are also prevented.

It is sometimes necessary to change an old foundation to accommodate a new arrangement, such as the compounding of low- and high-pressure steam cylinders, to increase the power of the engine. Whenever it is necessary to set an anchor bolt in an old foundation, the difficulty may be met in one of two ways. In the first method a hole is drilled in the concrete slightly larger in diameter than the bolt to be used and to the proper depth. A bolt is then prepared by cutting a slot in one end lengthwise of the bolt and about six or eight inches long. This slot is then fitted with a wedge of hardened steel held in place by a pin of soft copper or other soft metal. The bolt is lowered into the hole and struck several hard blows on the upper end with a heavy hammer. This shears the soft metal pin and drives the wedge into the slot, thus enlarging the diameter of the bolt at the lower end. The bolt is then grouted into the hole and the nut is tightened to complete the work.

In the second method a hole is drilled for the bolt as before. A second hole is then drilled laterally through the side of the masonry to meet the first hole and this is enlarged sufficiently to take the standard anchor plate. The work is completed in the customary manner, precautions being taken to grout the anchor plate to a firm bearing in the old concrete. The first method is cheap and simple, although there is no certainty as to what happens in the bottom of the hole. It also has the disadvantages of the grouted bolt previously mentioned. The second method, while it is more troublesome and expensive, is the more reliable and should be used in preference to the first.

The reciprocating engine, since the tendency to produce vibration is greater than in the case of the steam turbine, requires a comparatively heavy foundation. In some cases and in peculiar locations this advantage of the turbine may be so great that the choice of equipment is strongly influenced in its favor. The heavy foundation is expensive to build and, in the case of large units, the cost of the foundation forms a large percentage of the cost of installation.

Discharge Capacity of Safety Valves

A series of tests upon pop safety valves of the locomotive and inspector types to determine the discharge under 200 lb. steam pressure with certain fixed lifts.

The February issue of *The Journal* of the American Society of Mechanical Engineers contains the results of some tests made upon Crosby safety valves by Prof. E. F. Miller, of the Massachusetts Institute of Technology.

The tests were made to determine the discharge capacities of 3- and 3½-in. locomotive pop safety valves, Fig. 1, at varying lifts under 200 lb. steam pressure and of corresponding sized inspector valves of the flat-seated and bevel-seated types, Figs. 2 and 3, under 100 and 150 lb. steam pressure. In each case the spring was replaced by a spindle and the valves were set a definite distance from their seats. In order to avoid unequal expansion, the metal of the valve body and that of the spindle were made the same in the case of the locomotive valves; and the difference in expansion was similarly obviated, as far as possible, in the inspector valves.

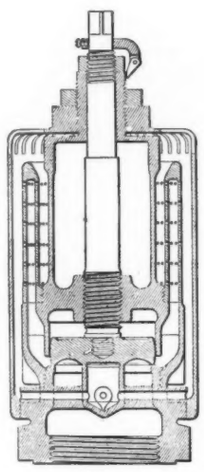


FIG. 1. MUFFLED LOCOMOTIVE TYPE

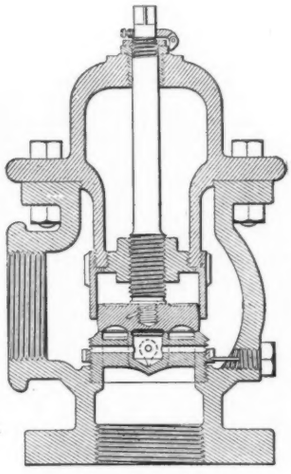


FIG. 2. FLAT-SEAT INSPECTOR TYPE

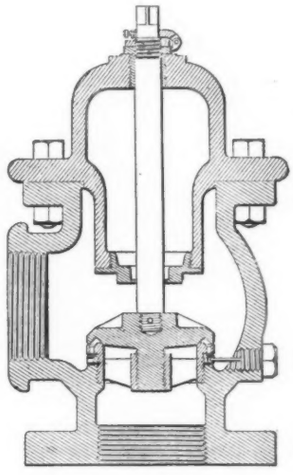


FIG. 3. BEVEL-SEAT INSPECTOR TYPE

Connection was made to the boilers through a 5-in. line and all the discharge was condensed in a surface condenser and weighed.

The additional lift due to the yielding of the metal because of the presence of steam pressure on the under side of the valve was determined in each case by placing the valve in a testing machine and subjecting it to a load corresponding to the steam pressure, the movement of the valve with relation to its seat being measured by a micrometer caliper.

The results of the tests are plotted in Figs. 4 and 5. As a result of these tests the muffled locomotive pop safety valve is now made as shown in Fig. 6.

In an addendum to Prof. Miller's paper, Mr. A. B. Carhart, of the Crosby Steam Gage & Valve Co., makes some general comments regarding pop safety valves. Quoting in part these remarks, he says:

"Pop safety valves were invented about 60 years ago and about 30 years later were perfected in this country and went into general use. Broadly, the invention consists of an addition to the disk of the valve so that when the valve is closed the addition is excluded from the action of the steam. However, when the valve opens the outflowing steam acts upon it and with the initial force causes the valve disk suddenly to rise higher and the spring to be compressed more than it would be with a force due to the steam pressure acting upon the original area only.

"The bevel-seated valves (Fig. 3) generally have this additional area at the periphery of the disk, outside of the seat, where it forms a chamber with a more or less contracted outlet at the extreme lip of the valve, through which all the steam must pass after escaping over the seat before it reaches the open air.

"As the seat is formed at an angle of 45 deg. to the vertical, the passage between the seat and the disk faces, when the valve opens, is diagonally upward, and what is called the lip of the valve is so related to this seat that the steam is forced to impinge directly upon it before being deflected downward toward the bottom of the chamber where it reacts. The effect of the impact upon the lip of the valve is increased by the expansive force of the steam acting in the lip chamber on account of the partial and momentary confinement before it passes into the open air. Sometimes openings are made through the lip or in the floor of the chamber, through which the steam escapes and so reduces the pressure within the lip chamber that the valve disk will not lift too high.

"Annular valves have the additional area located at the center of the disk and within the outer seat. This area is excluded from the action of the steam when the valve is closed, by means of an inner seat, but is acted upon directly by the steam when the valve opens. The disk is simply a flat cover for the valve base and has two concentric seats in the same horizontal plane. The central area of the disk, which is not exposed to the steam when the valve is closed, covers a well which communicates to the outer air through four hollow arms radiating from it out through the sides of the valve body.

"When the valve opens, the steam is discharged directly across the outer flat

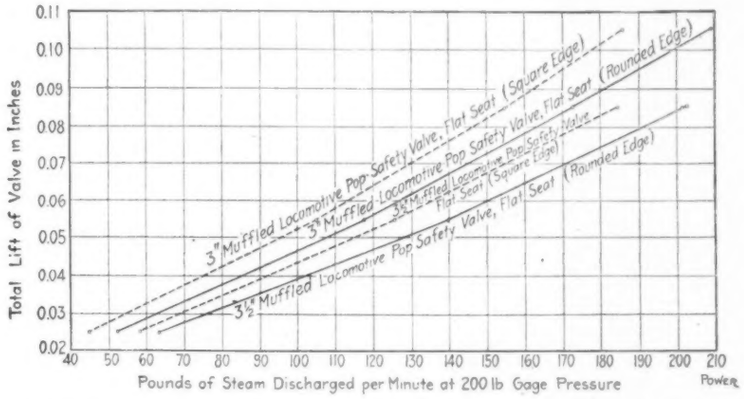

Total Lift of Valve in Inches
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210
Pounds of Steam Discharged per Minute at 200 lb Gage Pressure
Power
3" Muffled Locomotive Pop Safety Valve, Flat Seat (Square Edge)
3" Muffled Locomotive Pop Safety Valve, Flat Seat (Rounded Edge)
3½" Muffled Locomotive Pop Safety Valve, Flat Seat (Square Edge)
3½" Muffled Locomotive Pop Safety Valve, Flat Seat (Rounded Edge)

FIG. 4. RESULTS OF TESTS ON LOCOMOTIVE TYPE OF POP SAFETY VALVE

seat, and there is also a separate additional flow over the inner seat into the central well and out through the four hollow arms. The openings through these arms are controlled by a sleeve, threaded on the valve body, so that it may be turned upward or downward as desired. If it should close the open ends of the hollow arms, preventing the escape of the steam through the central well, the reactionary effect upon the disk to lift it against the spring would be greater than if the openings from the well were unobstructed; and by locating the sleeve at intermediate points the lift of the valve can be varied.

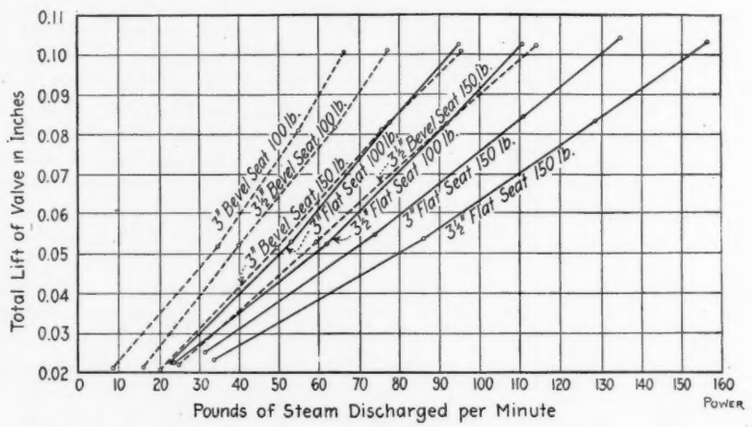


FIG. 5. RESULTS OF TESTS ON INSPECTOR TYPE OF POP SAFETY VALVE

"In bevel-seated valves the disk is ordinarily guided vertically so that it will return properly to its seat when the valve closes, by means of four or more radiating wings or vanes extending from the face of the disk in the steam space and bearing against the sides of the inlet or throat of the valve. But in the annular valve there are no guides or wings attached to the disk, which is simply a flat member having the truncated form of the central zone of a sphere.

"This is placed in a cylindrical chamber outside and above the steam space, and there it lifts or moves freely as acted upon by the steam against its lower face and by the opposed spring which presses upon it at its center. The contact between the chamber and the spherical part of the disk is the least possible, which permits universal movement of the disk without possibility of cocking or sticking, and yet insures that the disk will return accurately upon its seats when the valve closes."

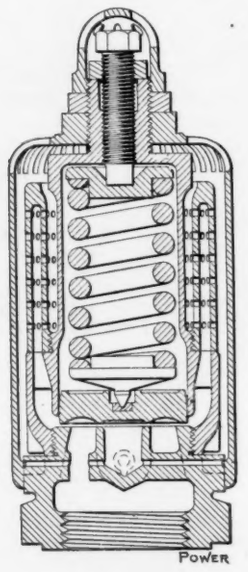


FIG. 6. MUFFLED LOCOMOTIVE POP SAFETY VALVE AS NOW MADE

Superheat and Vacuum Corrections in Steam Turbine Practice

In a valuable and interesting paper read before the Institution of Electrical Engineers at Manchester, on Jan. 16, K. Baumann gave what is believed to be the most complete set of correction curves for superheat and vacua which have yet been published.

He pointed out at the same time that too frequently turbines using different superheats are compared together, to the great advantage of that having the higher superheat. The percentage gain by a given amount of superheat is, moreover, nearly the same, whatever the initial pressure and whatever the vacuum. On the other hand, vacuum corrections vary considerably, he remarks, with the design of the exhaust end of the turbine.

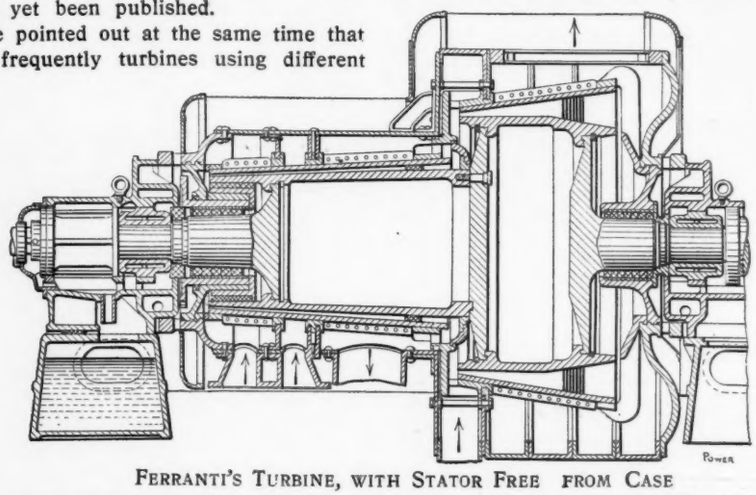
With the present design of high-pressure Westinghouse impulse turbines, he states that the following figures show the improvement in steam consumption with different vacua. An increase of vacuum from 26 to 27 in. diminishes the steam consumption by 4 per cent., from 27 to 28 in. diminishes the consumption by 5 per cent., and from 28 to 29 in. it diminishes the consumption by 6 per cent.

With exhaust-steam turbines the consumption continuously decreases, the thermodynamic efficiency falls off as follows: Increasing the vacuum from 26 to 27 in. diminishes the efficiency by 1 per cent., from 27 to 28 in. by 1 per cent., from 28 to 28½ in. by 1 per cent., and from 28½ to 29½ in. by 2.5 per cent. With exhaust-steam turbines the steam consumption improves by 11.5 per cent. with an increase of vacuum from 26 to 27 in., by 13 per cent. for an increase from 27 to 28 in., and 14.5 per cent. for an increase from 28 to 29 in. In these cases it should, however, be stated, that for the higher vacua exhaust turbines are designed with a higher "coefficient."

Mr. Baumann also gives pressure correction curves by which the actual pressure in the steam chest can be reduced to an equivalent standard pressure.—*Engineering.*

Ferranti's Turbine

In order to prevent distortion, and thus to permit drum turbines to run with closer clearances, Ferranti proposes to carry the stationary blades upon a stator entirely separated from the outer casing, or to provide separate organs to fulfill the different functions now performed by the casing alone, so that the stator is relieved of influences tending to produce unequal extension. The accompanying sectional drawing showing the proposed arrangement is reproduced from *The Mechanical Engineer.*



FERRANTI'S TURBINE, WITH STATOR FREE FROM CASE

Tom Hunter, Hoisting Engineer

By Warren O. Rogers

Several hoisting engineers are visited, and although some have clean, pleasant surroundings, others are obliged to work in dark, dirty engine-rooms.

Hoisting engineers receive practically the same pay, regardless of their ability, condition of plant and amount of work performed.

The more I saw of Hunter the better I liked him. Not only was he a companionable fellow, but he seemed to know his business, and I soon had a suspicion that he held a higher position than that of hoisting engineer, if the truth were known.

We met at breakfast the next morning after he had related his experience with overwinding and, as the day was fine, he proposed that we visit a few hoisting engineers in the vicinity, to which proposition I readily agreed.

During our ride to the mines in a street car the subject of hoisting engineers was broached and Hunter discoursed at length upon how engineers had made mistakes when the signals had been confused or the machinery had become deranged.

"There is as much difference in engines as there is in the men who operate them," said Hunter, as the car started. "Some men are always on the outlook for anything that may get out of order and others seem content to let matters take care of themselves, with the exception of an occasional inspection. The fact is, many hoisting plants are so dark and so dirty that an ordinary inspection will not disclose the defects."

Mine-car Operation

By this time the car had reached the end of the line and, alighting, we crossed a field and came to the first anthracite colliery I had ever visited. The cages in the two shafts were hoisted in rapid succession and, upon reaching the surface, the cars, which were filled with huge chunks of coal, were drawn up an incline by means of a barney-car and cable. After the coal had been dumped into the breaker rolls the barney-car was drawn back over the incline or plane and passed on its own track to the ground level, while the mine car returned to the ground level by taking the upper track.

As each empty car returned to the ground level, the section of track where the upper joins the lower track or incline lifted so that the loaded car was given a clear passage to the breaker. Then the movable section of track was lowered into place and the empty car would take the top instead of the lower track on its return passage. This method of handling the mine cars prevented congestion and kept the empty cars out of the way of those which were loaded.

The rapidity with which the shaft cages were handled greatly interested me, and I soon switched Hunter's conversation to this subject.

"You were speaking about inspecting hoisting machinery," I said, as we left the engine room and started for another which showed above a culm pile some distance away.

Need for Thorough Inspection

"Yes, the engineer in charge of a hoisting engine should make at least one thorough inspection each day. The cables require especial attention and the valve-gear links and auxiliary gear should also be carefully inspected. How a man is going to detect cracks and other defects in machinery which is covered with a thick layer of grease and coal dust is more than I can understand.

"But," I protested, "the engine rooms we have visited have not been so very dirty. They may not have been as shiny and clean as some high-grade power plants that I have seen, but for a coal mine are they not in as good condition as could be expected, considering the surroundings?"

"I admit that some are in fair condition," answered Hunter, "but I am going to show you a few engine rooms that are about as near perfection as commercial conditions will warrant—then some others."

"I suppose the attitude of the company determines the condition of the engine rooms to a considerable extent," I remarked, as we neared No. 9 colliery of the Pennsylvania Coal Co.

Ideal Conditions

"It does, as I will show you," replied Hunter, as he opened the door of the

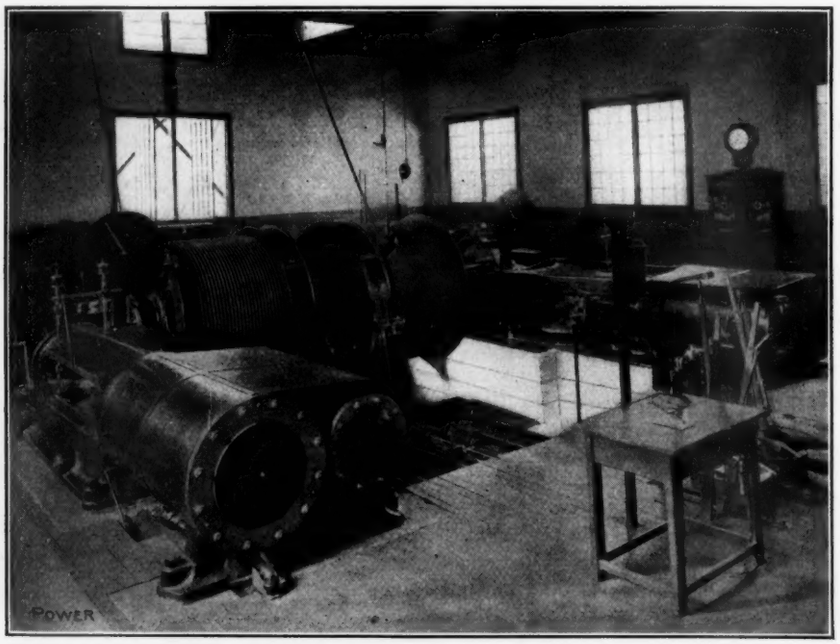
We Crossed a Field and Came to the First Colliery I Had Ever Visited

engine room at the Leadville shaft of the colliery. And indeed he did, for not only were the walls of the room painted a cream color, with a dark-red wainscoting, but the floor was also painted and varnished; the engines were painted a maroon color and all was as clean as it is possible to keep it. The ceiling was sheathed and oiled, so that it reflected the various apparatus in the plant.

Hunter introduced me to the engineer on duty who, on account of a slight accident to a slope engine, was not very busy and, therefore, had a little time in which to talk.

He told me that the company made regular inspections of its plants and rated the standing of each engineer according to the conditions in which the plant was found. He stated that his last mark was 99 per cent. perfect, and from the condition of the machinery and its surroundings I judged that he was the "top-notcher" of the company's hoisting engineers.

"This company," said Hunter, "encourages, and expects, its engineers to keep their plants in good order. I believe the company has the right idea, for a man can do better work under such surroundings as we find here than he can when the conditions are filthy."



A Well Kept Engine Room, the Engineer of which Rated 99 per Cent. Perfect

My visit to the various hoisting engineers showed me that I had a mistaken idea as to their standing. Those who are in charge of the better class of hoisting engines were bright, intelligent men, and I found out afterward that several of the outside superintendents I afterward met had at one time been employed as hoisting engineers. This goes to show that there is an opportunity for advancement for the engineer if he prepares himself to fill the position when the opening presents itself.

Where It Was Different

The next plant visited was about as dirty and as nasty as one could imagine. No attention was given to cleanliness and the engineer looked no more attractive than his engine. Grease, oil, coal dust, oil-waste and rubbish littered the floor, and the windows were thickly covered with grime, which added to the dinginess of the place.

Hunter grinned as he pushed me through the open door, and the grin broadened as the engineer started up and the clatter and grinding of the gears began. The engineer, however, was evidently at home in such surroundings, and he showed no signs that he was conscious that neither he nor his engine room was unpresentable. Compared with that of the engineer we had last visited, his standing would have been several degrees below zero.

"Let's get out of here!" I shouted in Hunter's ear, as a train of empty coal cars rattled past, and without waiting for a reply I made for the door, followed by Hunter.

"That is the worst I know off," he grinned. "I don't think there is another like it; if there is, I don't know where it is located."

"There must be a difference in the salaries of some of these men," I suggested, as we made our way toward a colliery farther down the valley.

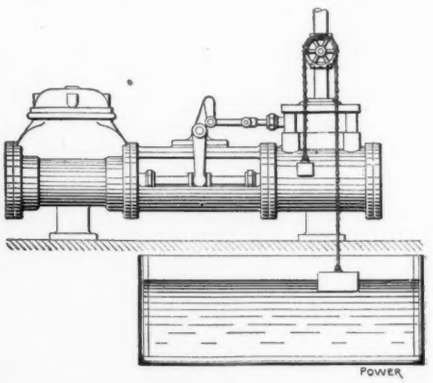
Well-doing Is Its Own Reward

"Well, there isn't; a hoisting engineer is a hoisting engineer in the eyes of the company. One man may be twice as efficient as another; but he don't get twice the pay. The only reward he gets is the knowledge that he is doing his work right, is keeping his plant clean, and that he stands a chance of promotion. It is a safe bet that our last engineer will not be selected for a position higher up."

We returned to the hotel that night tired and hungry, and after dinner we were well content to retire to our rooms after a profitable day spent among hoisting engineers.

Automatically Operated Duplex Pump

In mine practice it is not always convenient to discharge the cooling water used in the cooling jackets of air compressors, where it will run to some convenient place out of the way. In one instance it was necessary to discharge this cooling water into a tank under the floor of the compressor room.



Valve Operated by a Float

In order to keep the water level in the tank uniform, a pump was used, which discharged the water at a distant point. The steam pipe of the pump had a globe valve, the stem of which was fitted with a sprocket wheel. A sprocket chain ran over this wheel, one end being attached to a suitable weight and the other to a float in the tank which was directly under the pump. As the height of the water increased or decreased, the float opened and shut the valve, so that the water level was kept practically constant.

Water Power Law Upset

The Wisconsin Supreme Court, in a decision issued Jan. 30, held the water-power law enacted by the 1911 Legislature unconstitutional. The law sought to vest in the state all rights to water power heretofore held by corporations and individuals, subject only to lease. The decision was the unanimous conclusion of the justices.

The court declared the law involved the wrong conception of the state's interest in the power element of navigable waters and the capacity to deal with it.

Notes on Metering Coal

Some interesting notes upon metering coal have recently been compiled by the O. D. Havard Co., maker of the Havard coal meter. This meter was described in our Mar. 29, 1910, issue and consists essentially of a spiral vane placed centrally in the vertical part of the coal chute. The vane is caused to rotate as the coal passes down the pipe and these rotations are recorded on a chart or dial.

For the accurate operation of this device with steam sizes of hard coal, the pipe must be completely filled with coal at the meter and the cross-section of the coal must move uniformly. If the coal should fall on the meter in a shower, the revolutions of the vane will bear no fixed relation to the amount of coal passing, and when the cross-section of

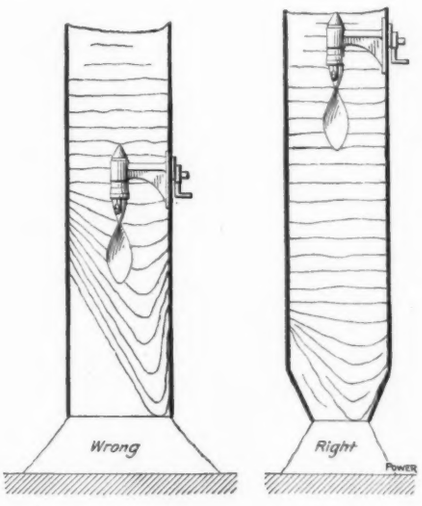


FIG. 1. WRONG AND RIGHT WAYS FOR COAL TO STRIKE METER VANE

the coal does not move uniformly, there will be a shearing across the vane, which will affect the accuracy of the reading. This condition is illustrated in Fig. 1. Furthermore, the meter should always be placed as far as possible above any influence tending to disturb the stream of coal, such as a branch, sharp turns or an open valve in the line. Also, it is important to have the pipe as nearly vertical as possible.

In the matter of soft coal the requirements are said to be more exacting on account of the varying sizes of the lumps and because it does not flow as freely as hard coal. This is overcome by decreasing the diameter of the vane, increasing its length and protecting it from the impact of large lumps by a conical shield placed at the top, as shown in Fig. 2; it having been found that without this shield the lumps struck the edges of the vane and caused it to stop until the lump had descended.

An idea of the accuracy of these meters may be gained from the following figures taken from the records of fourteen meters in one plant:

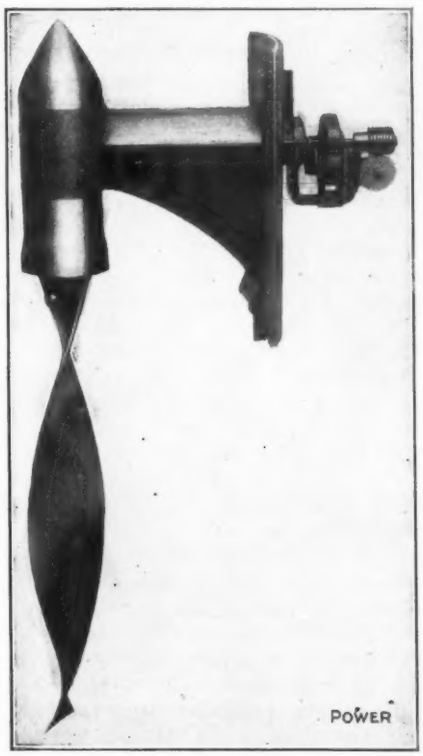


FIG. 2. METER DESIGNED FOR MEASURING SOFT COAL

	Meters, tons	Inventory, tons	Variation, per cent.
Jan.	3,443	3,364	+2.35
Feb.	3,086	2,904	+6.25
Mar.	2,997	2,922	+2.50
Apr.	2,573	2,495	+3.13
May	2,414	2,439	—1.03
June	2,364	2,341	+0.98
July	2,662	2,791	—4.63
Aug.	2,846	2,880	—1.18
Sept.	2,618	2,604	+0.54
Oct.	2,437	2,441	—0.164
Nov.	2,945	2,824	+4.3
Dec.	2,975	3,080	—3.4
	33,360	33,085	+0.83

Combustion of Pulverized Coal

In a paper read before the American Institute of Chemical Engineers, L. S. Hughes summarized the advantages of using pulverized coal and discussed the difficulties encountered in its use. The chief difficulty has been the destruction of the firebox and crown-sheet. Both bricks and steel "melted" little by little, which effect has been attributed to the high temperature of the flame produced by pulverized coal.

When the temperature of the flame was reduced, the grate bars, crown-sheet and walls of the firebox became covered with a vitreous, adherent coating of slag or clinker. This clinker is similar to the slag produced in blast furnaces and is evidently formed by the action of the silica of the ash with iron oxide forming a complex fusible silicate. The silica would also act on the firebrick by reducing its melting point.

The remedy suggested and tried consisted in introducing powdered limestone with the coal dust. A simple air-blast injector fed the coal into the firebox and a small amount of limestone, roughly equal in weight to the ash of the coal, was introduced with it. Immediately the character of the ash formed changed from a sticky shower to a dry, pulverulent dust which displayed no tendency to cohere or clinker in any way.

Large Turbo-Compressors

Our English contemporary, *Engineering*, publishes in its issue of Dec. 15 a description of several turbo-compressors built by Pokorny & Wittekind, of Frankfort-Bockenheim. One of these, installed at the Reden mine, near Saarbrücken, in 1909, runs at 4200 r.p.m., handles 247,000 cu.ft. of air per hour, and delivers it at a pressure of seven atmospheres absolute, about 100 lb. per sq.in.

Another, installed in Westphalia, runs also at 4200 r.p.m., has a capacity of 353,000 cu.ft. of free air per hour, delivered at a pressure of eight atmospheres, or 118 lb. per sq.in. The isothermal efficiency of the compressor varies between 64 and 65 per cent., and the steam turbine works with exhaust steam at efficiency of about 68 per cent., and with boiler steam at an efficiency of about 66 per cent. There is also a 4000-hp. electrically driven compressor for the Rand mine to handle 1¼ million cu.ft. of air per hour at a pressure of 128 lb. per sq.in., with an efficiency of nearly 68 per cent.

Utilizing Ontario's Peat Bogs

It is announced by the Canadian government's mine department, reports U. S. Consul H. A. Conant, that the associated manufacturers at Brantford, Ont., have become so convinced that the air-dried peat method employed by the mines branch can be made a commercial success that they have contracted with the government to continue the work at Alfred, Ont., and will spend over $50,000 in trying to improve peat machines. This action was decided on only after a thorough investigation. The machine to be used will have a capacity of 60 to 80 tons per day, as compared with the 30 tons the government turned out.

The government experimental plant at Alfred exhibited samples of machinery and of peat ready for market at the Ottawa fair. A thousand tons of peat were made up, which was sold at $3.25 a ton. The orders came with such a rush that the supply was soon exhausted. The peat was used in parlor grates, in kitchen ranges, and in furnaces. It burns to a fine ash, there being practically no residue, and is much cheaper than coal.

Gas Power Department

Worth-while gas-engine and producer information treated in a way that can be of practical use

Comparison of Gas, Oil and Steam Motive Powers

By R. E. Mathot

It may be stated, as a principle, that every system of motive power is good and reliable, provided it is properly applied in view of meeting the requirements of each particular case. It would not be wise, for an example, to install a costly gas plant in a sugar mill needing an enormous quantity of steam and having a very short manufacturing season of a few months. For similar reasons, the cost of operating a Diesel engine plant would be extravagant in countries located far from the oil fields or in such countries where crude fuel oil is burdened with prohibitive duties.

Besides the foregoing considerations of primary importance there is another one which seems to be too often disregarded by those who have to select a motive power; I refer to the load factor, or the relation between the normal average load and the maximum power the engine is expected to be able to supply momentarily.

The question of space required also must not be neglected, because the cost of the buildings containing the power equipment and fuel depends on it. In this particular the Diesel engine has the advantage over any other kind of prime mover, because it does not require any boiler or producer and the volume of fuel is the smallest.

The accompanying tables show the comparative costs of installation and operation for 3000-hp. power plants equipped with different types of prime mover. In fixing the number of units which are necessary for realizing the 3000 hp. maximum under consideration, I have taken into account different factors derived from practice, such as reliability, allowing the number of spare units to be reduced; margin of power, depending upon the system; influence of load variations upon the fuel consumption; facility of attendance, etc. I have considered four Diesel engines, three of which would be running while, owing to the facility of starting, the fourth engine would be at standstill but ready for service in case of need.

In the producer-engine plant I have reckoned upon five units of 600 hp. each, because this power is easily realized from single-acting, twin two-cylinder engines connected by couplings, with the flywheel in the middle. For some time this kind of engine has met much favor in the manufacturing industry. It is cheaper to build and its upkeep and attendance are simpler than the double-acting engine which seems to be preferable on the Continent for power above 1000 hp. Moreover, the single-acting engine with trunk pistons works better with suction producer gas without requiring the thorough purification necessary in the case of steel works using blast-furnace or coke-oven gas.

I have considered suction producers for feeding the five engines in preference to pressure producers because the former are simpler and less expensive. They are also less cumbersome and of higher efficiency. I have reckoned upon ten producers of 300 hp. each, plus two generators which would constitute the spare apparatus.

Bituminous producers have not been considered because for economic working they involve the installation of a recovery plant for ammonia, tar, etc.

The working dimensions of the engines have been calculated for a margin in power of 10 to 20 per cent.; to this end they should develop the 600 hp. with a mean effective pressure on the pistons of 65 lb. per square inch, although in good modern engines this pressure easily reaches 80 lb.

The German semi-portable steam engines, although units of 800 to 1000 hp. have not been long in industrial use, have proved their remarkable qualities. The self-contained boiler and engine form a compact equipment which needs no expensive foundations. The exceptionally low fuel consumption, which is less than 1 lb. of gross coal per brake horsepower-hour, allows the use of a small chimney. The semi-portable engine has a large margin of power; therefore it is unnecessary, as with turbines or other steam engines, to have spare units.

For the other steam plants I have assumed the installation of one or two additional boilers for the purpose of cleaning or repairing. The Lancashire type of boiler with two or three corrugated internal furnace tubes, without Galloway tubes, has been chosen. This kind of boiler, with its large volume of water, presents the advantage, as compared to the tubular boilers, of a large margin of steam production. It has a high efficiency at the rate of 3 to 3½ lb. of water evaporated per hour per square foot of heating surface and can attain 5 lb. without sensible priming, giving then 8½ lb. of steam per pound of good coal.

For some years, by virtue of the use of corrugated steel flues and plain drop-forged ends of large diameter, these boilers have been constructed for pressures up to 215 lb. per square inch, with heating surfaces as large as 1600 sq.ft. per boiler.

For establishing the cost of operation for each type of motive power, appropriate rates of depreciation derived from practice have been used. In this respect the Diesel engine may be considered on the same basis as fuel-gas engines of good construction, and could be written off within 10 years, while 15 years would be required for semi-portable steam engines and turbines and 20 years for stationary steam engines of the Corliss, Sulzer and piston-valve types.

The costs of upkeep and repairs are not mentioned here, as they depend almost exclusively upon the original quality of construction and workmanship and also upon the character of attendance and supervision. The cost of labor for each type of plant has been taken into account, but these costs are applicable only to Belgium, where wages are relatively low.

COMPARATIVE INSTALLATION COSTS FOR A POWER PLANT OF 3000 HP.

For a Factory Utilizing an Average of 2000 Hp. and a Minimum of 800 Hp. During 300 Days per Year, 24 Hours per Day

Diesel-type Engines		
Four 800-hp. engines at $29,000 each	$116,000	
Foundations, pipings and connections	4,000	
		$120,000
Suction Producers and Engines		
Five 600-hp. engines at $13,200 and ten 300-hp. producers at $2000 each	$86,000	
Two spare producers	4,000	
Foundations, pipings and connections	6,000	
		$96,000
Semi-portable Steam Engines		
Five 600-hp. engines at $17,000 each	$85,000	
Masonry, connections and stacks	3,000	
		$88,000
Turbo-alternators		
Three 750-kw. units at $16,600 each	$49,800	
Foundations and piping	3,000	
Eight Lancashire boilers, 1300 sq.ft. of heating surface each	16,000	
Masonry for boilers	2,800	
Flues and stacks	1,400	
Automatic stokers	2,400	
Superheaters	3,200	
		$78,600

Piston Steam Engines

Two 1500-hp. engines	$30,000	
Foundations and connections	5,000	
Seven boilers of 1300 sq. ft. heating surface each	14,000	
Masonry for boilers	2,400	
Flues and stacks	1,200	
Automatic stokers and heaters	4,800	
		$57,400

COMPARATIVE ANNUAL LABOR COSTS

CRUDE-OIL ENGINES

Four engines require

Two engineers at 13c. per hour	$0.26	
Three laborers at 6c. per hour	0.18	
Total	$0.44	
Per year: 300 days × 24 hours × $0.44		$3,168

FUEL-GAS ENGINES

Five engines require

Three engineers at 13c. per hour	$0.39	
Five stokers at 9c. per hour	0.45	
Five laborers at 6c. per hour	0.24	
Total	$1.08	
Per year: 7200 × $1.08		$7,776

SEMI-PORTABLE ENGINES

Five engines require

Three engineers at 13c. per hour	$0.39	
Five stokers at 10c. per hour	0.50	
Five laborers at 6c. per hour	0.30	
Total	$1.19	
Per year: 7200 × $1.19		$8,568

TURBO-GENERATORS

Three engines require

Two engineers at 15c. per hour	$0.30	
Two stokers at 10c. per hour (The boilers are provided with automatic stokers)	0.20	
Three laborers at 6c. per hour	0.18	
Total	$0.68	
Per year: 7200 × $0.68		$4,896

PISTON STEAM ENGINES

Two engines require

Two engineers at 13c. per hour	$0.26	
Two stokers at 10c. per hour (Automatic coal feeders)	0.20	
Three laborers at 6c. per hour	0.18	
Total	$0.64	
Per year: 7200 × $0.64		$4,608

ANNUAL EXPENDITURE FOR FUEL

AVERAGE LOAD, 2000 HP. DURING 300 DAYS OF 24 HOURS EACH, GIVING 2000 × 24 × 300 = 14,400,000 BRAKE HORSEPOWER-HOURS PER ANNUM

	Per Year
Diesel-type Engines Consuming about 200 gr. of crude oil per brake horsepower-hour. Russian or Texas oil costs $1.40 per 100 kg., giving a cost of 0.28c. per brake horsepower-hour or $0.0028 × 14,400,000 =	$40,493
Producer Gas Engines Consuming at variable load per brake horsepower-hour 400 gr. of lean coal, which costs $3 a ton, or 12c. per brake horsepower-hour; $0.012 × 14,400,000 =	$17,280
Turbines At variable load consuming about 6 kg. of steam per brake horsepower-hour, which gives a consumption per brake horsepower-hour of 7.5 kg. of steam = 1 kg. of coal at $3.20 a ton, or 0.32c. per brake horsepower-hour; $0.0032 × 14,400,000 =	$46,080
Semi-portable Steam Engines Consuming per brake horsepower-hour 520 gr. of semi-bituminous coal at $3.20 a ton or 16.64c. per brake horsepower-hour; $0.1664 × 14,400,000 =	$23,962
Piston Steam Engines Consuming 4½ kg. of steam per indicated horsepower-hour or 5 kg. steam per brake horsepower-hour. With a normal evaporation of 7½ kg. of steam per kilogram of semi-bituminous coal, one brake horsepower-hour requires 0.665 kg. of coal, at $3.20 a ton, giving 21.28c. per brake horsepower-hour; $0.2128 × 14,400,000 =	$30,643

Considering the plants are supposed to work day and night without interruption, the rates and interests and depreciation have been calculated upon nearly relative short time.

It should be borne in mind that the figures for labor fuel consumption and working apply to Belgium, where they are sensibly lower than in America. For United States said figures should be increased accordingly with the exception of the price of crude oil.

COMPARISON OF THE PRINCIPAL ANNUAL OPERATING COSTS

Type of Equipment	Depreciation Rate	Fixed Charges*	Fuel	Attendance	Annual Total
Diesel engines	15½ %	$18,600	$40,493	$3,168	$62,261
Producer gas	15½ %	14,880	17,280	7,776	39,936
Semi-portable steam	12.9%	11,352	23,962	8,568	43,882
Turbines, etc	12.9%	10,139	46,080	4,896	61,115
Piston engines, etc	11.3%	6,486	30,643	4,608	41,737

*Depreciation plus 5% interest on investment.

Exhaust Pipes for Gas Engines

BY F. B. HAYS

The exhaust from a steam engine can be used for many purposes and is piped from the engine to heat buildings, dry stock, etc. The exhaust from an internal-combustion engine consists principally of carbon dioxide, water vapor and nitrogen, which, combined as they are, are entirely useless for any commercial purposes. As these gases cannot be put to any practical application they should be discharged directly into the atmosphere at the exhaust port of the engine in order to secure the greatest thermal efficiency of the latter. However, this is rarely found practical because of the disagreeable and injurious odors of the exhaust gases, so they are generally piped to some point outside the building containing the engine, for which purpose some form of pipe is used.

As the function of the exhaust pipe is simply to carry off inert products of combustion from the engine, its construction seldom receives any engineering attention, and consequently it is installed in the quickest, cheapest, and most convenient manner possible. The result of this almost always is decreased engine efficiency due to back pressure produced by incorrectly constructed exhaust pipes.

The arrangement of exhaust pipe which produces the least back pressure is that which passes directly from the exhaust port of the engine to the outside of the building, the pipe being a straight "run" extending from the engine cylinder to the nearest external wall. The only back pressure produced by this sort of exhaust pipe is due to the friction between the moving gases and the internal wall surface of the exhaust pipe. A perfectly straight, direct exhaust pipe is seldom found in actual practice, as it forms a barrier from the engine to the wall of the building and occupies space that can generally be employed to better advantage. For these reasons the arrangement shown in Fig. 1 is mostly used, although it is more expensive to construct. This form of exhaust pipe produces great back pressure, due to the sharp turns and the projections of the butt ends of the pipe into the elbow connections. The course of the exhaust gases in this type of pipe is indicated approximately by the arrow heads. Besides the cross-currents shown, eddy currents are also produced by the gases striking the butt ends of the pipes, so that there are three sources of back pressure.

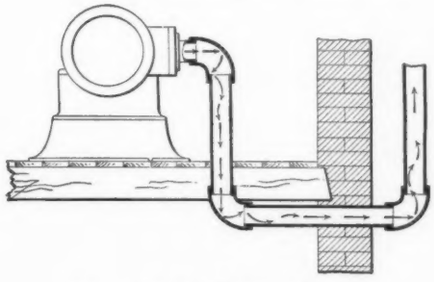


FIG. 1. THE WRONG WAY

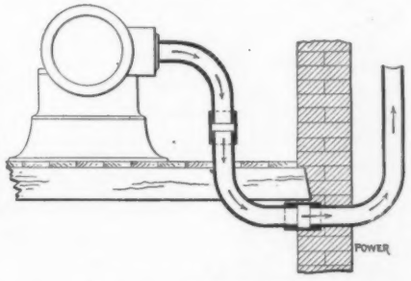


FIG. 2. A BETTER WAY

A type of exhaust pipe which has the advantage of both of the types referred to, without the disadvantages of the second, is shown in Fig. 2. This arrange-

ment allows the pipe to be run under the floor and at the same time eliminates the cross-currents and eddy currents produced by short bends and projecting pipe ends. The construction is evident from the figure. Such an exhaust pipe can be installed almost as cheaply as the one in Fig. 1, and it eliminates all back pressure except that due to wall friction.

The Marine Diesel Engine

Experience with the Diesel engine in marine service has developed the advantage that the air in the engine room is continuously changed by reason of the demand by the engines for air for combustion. The engine-room air, therefore, cannot become stale and unwholesome as long as the engines are running.

This sanitary advantage, however, is accompanied by the disadvantage that the engines do not radiate sufficient heat to keep the engine room warm in cold weather. Builders of oil-power vessels, therefore, are confronted with the problem of devising means for heating their engine rooms!

LETTERS

Timing the Ignition

Earl Pagett's recent letter on a method of timing the ignition of an internal-combustion engine prompts me to describe the method I generally use for this purpose—a method which is not unique by any means but which I do not remember having seen described in POWER before. When the crank is on the inner center, I place an adjustable-angle spirit level on the top of the crank web and read the angle at which the level must be set to the straight-edge in order to get the bubble central. If it is desired that the engine shall fire 20 deg. ahead of dead center, I set the spirit level 20 deg. steeper to the straight-edge, place the straight-edge on the crank web, and turn the engine round until the desired position is reached. Then the ignition trip or timing gear can be adjusted to spark at that point. For valve timing the method of procedure is exactly similar, but for the out-center timings (inlet closing and exhaust opening), it is necessary to obtain a fresh base to work from with the engine at outer center, since the webs are not always machined exactly parallel.

Allowing for the comparatively rough planing or milling of the crank webs, I should prefer this method to Mr. Pagett's, since one obtains the results right away in degrees and avoids the errors introduced into Mr. Pagett's method by the indefinite length of the flywheel circumference and the difficulty of measuring linear distances to the second place of decimals around the rim. An adjustable-angle spirit level will not be found in every plant, I know, but one which will be good enough for the job may be bought very cheaply and once bought, the level will be found to be very convenient for many purposes.

JOHN S. LEESE.

Manchester, Eng.

Starting Suction Gas Producers

There are a great many suction producers in operation throughout the country on intermittent service and putting them in operation again after a night's shutdown constitutes the greater part of the labor necessary to their operation. The writer spent some time in a plant that was in continuous operation, except for eight or nine hours on Sunday, providing electric service to a town of about 5000 inhabitants and our experiences in putting producers in operation after the Sunday shutdown may prove of interest.

Upon shutting down on Sunday morning the fires were not cleaned, as was customary in the early morning, but the producers were filled with coal and left standing with the purge pipes open. The first thing was to clean the fires; any clinker that could not go through the grates must be removed and also the ash accumulating around the sides of the producers. Considerable care was necessary to get around the entire circumference without having the fire fall down and block the work. Next, the fires were sliced down from the top and by keeping well to the sides the ash was worked down to the grates.

The producers were then fired, but were not filled, for occasionally it was necessary to add fuel later, to maintain uniform conditions. The fires were then barred from the bottom. In this operation a slicing bar was worked across the grates to loosen and break up any clinker that might not have been reached in cleaning. The center of the fire was then lowered by shaking the grates until it fell through into the ashpits, and the ashes were removed. During these operations one must keep well away from the front of the open doors for there is no draft to remove the gas and it very often puffs out in explosions that are dangerous.

After this preparation, the fires were blown with the blower until the gas burned at the test cocks on the producers, when the valves on the lines to the purge pipe were closed and those on the line to the engine were opened. As soon as the gas burned at the vents at the engines, the blast was turned off and the vaporizers were cut in, care being taken that the vaporizers were in working order and not plugged with deposit. To keep the temperature of the fires down until the vaporizers began to furnish steam, a small amount of water was usually run into the ashpits.

The engines were then started and the scrubber water turned on. Occasionally, when in a hurry to start, only one producer was cleaned and started and the other was cut in later after the engines had been running for some time.

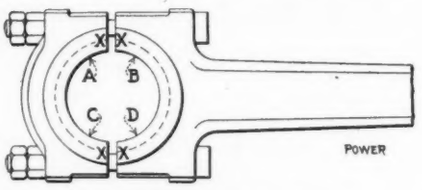
During the week, the fires were cleaned at 4 o'clock, morning and afternoon, and coal was added five times during the 24 hours. The fires were poked once, in addition to the cleaning periods, each day. Our best results were obtained by operating the producers on a light load and avoiding the high temperatures which come with heavy loads. By so doing, there was very little poking and the quality of the gas was kept very uniform.

J. C. PARMELY.

Kewanee, Ill.

An Unusual Cause of a Hot Crankpin

While on installation work recently, I ran across a peculiar case of trouble that developed on an engine which had been installed two months previously. It was a crankpin which would not run cool and which finally burned out four sets of boxes in which experts from both Boston and Roxbury had been unable to locate the cause of the trouble. I succeeded in getting rid of the trouble absolutely in two days of nine hours each and operated the engine three days continuously under full load, with an average temperature at the crankpin of 90 deg., running 24 hours.



CRANKPIN END OF ROD

Upon scraping the babbitt clear of rough places caused by the overheating, I put them back in place, first coating the crankpin with Prussian blue, and turned the engine over through a couple of revolutions. Taking the boxes out showed that they touched the crankpin only from *A* to *B* on top and *C* to *D* on the bottom, although I got a good bearing all around with the boxes held on the crankpin by hand instead of in the connecting-rod. Trying the brasses again in the end of the rod, easing them in by hand, indicated a binding at the edges *X* of the jaws, and caliper measurements showed that the outside diameter of the brasses at the corresponding points was a shade larger than the diameter of the jaw circle. Filing the brasses so they slipped into their seats without forcing remedied the trouble.

D. L. FAGNAN.

New York.

Electrical Department

Conducted to be of service to the men in charge of electrical equipment in the power house

An Ingenious Emergency Arrangement

By A. S. Specht

In a large manufacturing plant near Boston, electric power is supplied by both alternating and direct currents. The direct current is generated by a local plant comprising reciprocating engines belt-connected to compound-wound generators running in parallel.

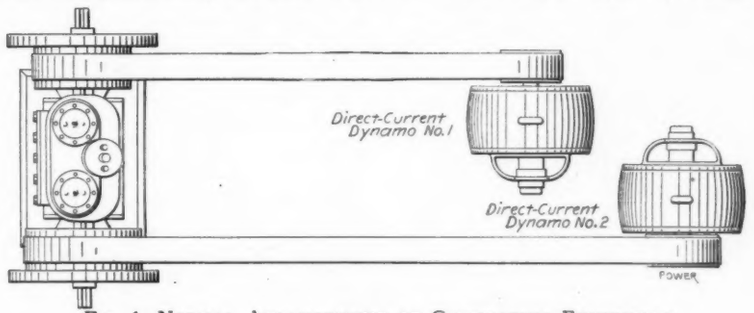


Fig. 1. Normal Arrangement of Generating Equipment

Recently it became necessary to shut down one of the engines for repairs; this was a vertical engine and it had been driving two of the generators, arranged as in Fig. 1. One of these generators could be dispensed with, but not both, because the peak load was too heavy.

There happened to be available an idle alternating-current generator, and, as there was a plentiful supply of alternating current, it was decided to slip this generator into the position occupied by No. 1 direct-current machine and run it as a synchronous motor to drive No. 2 machine, utilizing the engine shaft as a jackshaft, and the same belts.

Some provision had to be made for starting this set and getting the alternating-current motor up to speed and into synchronism, and in order to accomplish this it was decided to run No. 2 direct-current generator as a motor until the alternating-current machine got on the line. Accordingly, connections were made as in Fig. 2, the water rheostat consisting of a tight barrel filled with water and equipped with a couple of old pipe fittings bolted to the leads for electrodes.

At first clear water was used, but it was found to be of too high resistance. Therefore, a bucket of salt was thrown in the barrel and the water stirred up; this increased its conductivity enough to bring the set up to speed. A short-circuiting switch was used to cut out the ammeter in order to prevent it from trying to indicate backward and possibly damaging the pointer.

With one electrode pulled out of the barrel and all switches open, the operation of starting is as follows:

Close the switch short-circuiting the ammeter; throw No. 1 switch up, short-circuiting the series field winding; turn the field rheostat to cut out all of the resistance; throw in the circuit-breaker and the main switch, No. 2; lower the top electrode into the barrel very slowly until it comes in contact with the bottom one, and then close switch No. 3; cut in field resistance until it is up to speed, when No. 2 switch cutting out the water rheostat, and pull the top electrode out of the barrel; then increase the speed of the machine by slowly cutting in the resistance of the field rheostat, to get the alternator into synchronism.

After the alternating-current machine has been synchronized and cut in on its line, running as a motor, trip the direct-current circuit-breaker and pull the main switch (No. 2) out. Turn the field resistance all in and throw No. 1 switch down, which puts the series field winding into normal connection with the equalizer. The machine is now ready to be built up again as a compound-wound generator.

[It is not necessary to open the direct-current leads after the alternating-current machine has been thrown on its line. As soon as this has been done, the field rheostat lever or wheel may be turned two or three points in the "all out" direction and the ammeter put back in circuit; then the rheostat can be adjusted until the ammeter shows no armature current. Throwing the switch No. 1 downward will then put the machine in circuit normally and the field rheostat can be adjusted to make it take its share of the load.—Editor.]

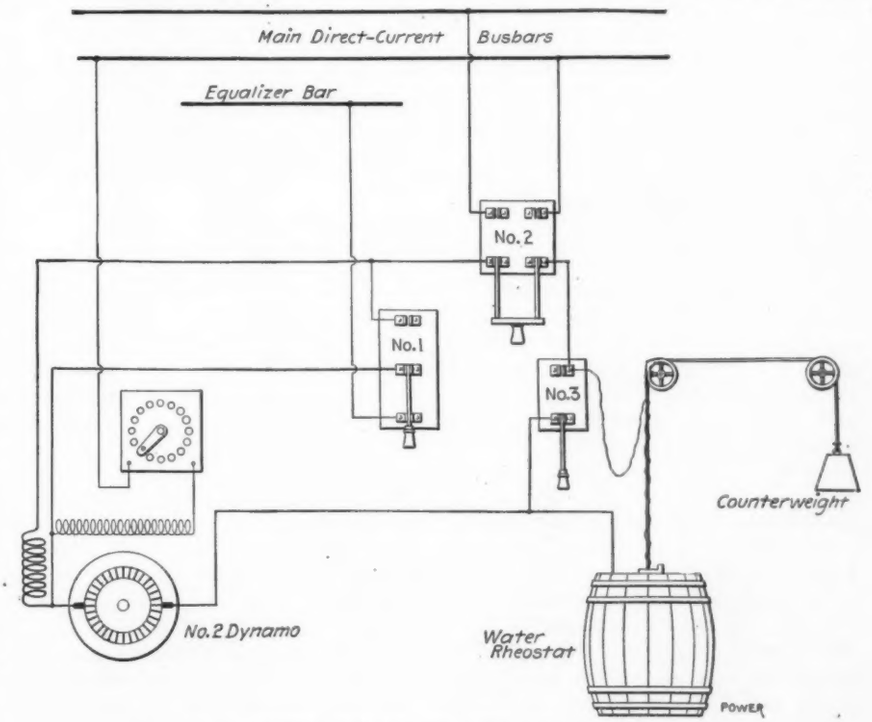


Fig. 2. Emergency Connections for Starting Up

Safety Device for Traveling Cranes

By E. H. Marzolf

It frequently happens around steel mills that men are required to work on the bridge rail of an electric traveling crane. This places them in an extremely dangerous position, even though the crane operator has been notified to that effect, for there is always the chance of his forgetting or becoming careless.

To provide against accident in such cases the writer has planned a safety device consisting essentially of an automatically operated switch which reverses the direction of the motor when the crane comes within the danger zone.

Very often with large cranes a flat bar or T-rail is used instead of a trolley wire, and in such cases the application

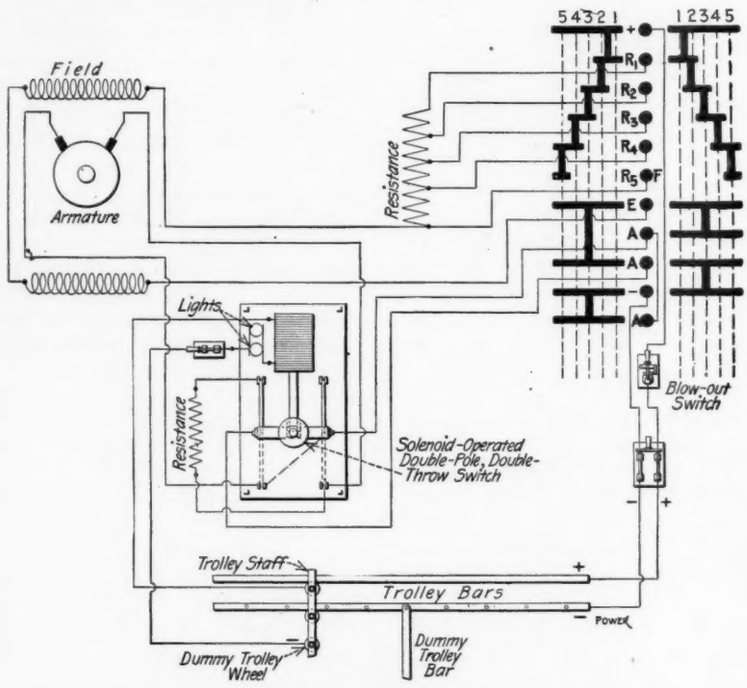


Diagram of Connections

of the safety device is very simple. Holes are drilled in the bottom rail about 15 or 20 ft. apart and through them are hung short bars about 2 ft. long. Ordinarily these are kept up out of the way, but when a man is working on the track he lets down the nearest bar to the place at which he is working.

If the crane is traveling toward him and the operator does not stop it before coming to the auxiliary rail, a dummy trolley wheel carried on the main trolley staff will make contact with the rail. This closes the circuit through a solenoid which throws a double-throw double-pole switch and reverses the polarity of the armature. A diagram of the connections is herewith shown.

A resistance is placed in series with the armature to prevent damage to the latter from the sudden rush of current. A red light is in series with the solenoid so as to indicate to the operator what has happened.

The device has been tried out thoroughly and has given entire satisfaction.

LETTERS

Field Excitation and Load Division of Alternators in Parallel

Will someone please explain why, when two alternators are running in parallel, if one tends to run a little faster than the other the field ammeter on the machine doing the most work does not indicate as much as the one doing less work?

Of course, both machines are running at the same speed when in parallel, but not when disconnected from each other.

V. C. Morris.

Mogollon, N. M.

[Field excitation does not determine the division of load between alternators; that depends on the driving power applied to the respective machines. If the two machines deliver equal voltages at no load when running at equal speeds and with equal excitations, speeding one of them up will necessitate reducing its excitation in order to keep the voltages equal. When the machines are paralleled, the one that has been running the faster will take more load than its mate, because of the governor setting and in spite of the weaker field excitation, but its power factor will be lower than that of the other machine and cross-currents will flow between them. We shall be glad to publish comments from readers of Power.—Editor.]

Automatic Exchange of Excess Loads between Two Systems

In the plant where I am employed there are in regular operation a 600-volt direct-current system for street-railway service and a 2200-volt alternating-current system for lighting and motor service. Sometimes the railway load is heavy while the lighting load is moderate, and at other times the alternating-current load is relatively the heavier. In order to enable one system to help out the other one under either of these conditions, we decided to tie them together electrically. Accordingly, a 200-kw., 550-volt, compound-wound, direct-current generator and a 180-kw., 2200-volt, alternating-current generator of about the same speed were purchased second-hand, both being nearly as good as new. The pulleys were removed and the shafts connected by a flexible coupling. A starting box was connected up for starting the direct-current machine as a motor and the alternator was provided with the usual connections for parallel operation with the main units.

The improvised motor-generator set now floats between the two systems very nicely and automatically. The set is in operation every day and is frequently loaded to the capacity of the alternating-current machine when there is a heavy peak load on the railway system. When the railway load is light it operates as a direct-current motor and an alternating-current generator, taking up to 60 per cent. load, and would take more, but we adjust the rheostat to hold it within this limit, for when it takes much more than this the current passing through the series field winding in the direction opposing the shunt field weakens the total field so much that the machine speeds up until its load throws the circuit-breaker. By adjusting the field rheostat of the direct-current machine several times a day it very seldom throws the breaker.

When this way of operating the set was mentioned to some engineers they would not believe it until they saw it, and one engineer came over 100 miles to see it.

Chas. E. Nigh.

Morgantown, W. Va.

The more nearly steel approaches a pure iron, the longer it resists corrosion. Wrought iron, notwithstanding its slag, is the nearest approach as the slag is mechanically mixed and does not interfere with the chemical properties of the product, says an exchange. Cast-iron pipe, properly casted, is good for a hundred years and under almost any condition of soil.

Refrigeration Department

Principles and operation of ice-making and refrigerating plant and machinery

Overhauling an Ice Plant

By W. S. Luckenbach

The season is at hand for starting up the refrigerating plant. It is essential that the engineer of an ice or refrigerating plant take advantage of every possible economy from the steam boiler to the dump tub, in order to produce the largest possible quantity of ice or refrigeration at the least cost.

Steam Boilers

One of the principal expenditures of an ice plant is for fuel. Hence any improvements that tend to reduce the fuel consumption is money well invested, and if the following adjuncts are not already installed, it would be well to consider them. First, a feed-water heater and purifier of ample capacity is a great help because the water will enter the boiler near the boiling point and foreign matter that would otherwise accumulate in the boiler will be precipitated. It is clear that the less impurities fed into the boiler the less there will be to blow out, and the boiler will steam more easily as the tubes will be comparatively free from scale. While a high-and-low-water alarm is not an actual necessity with a careful fireman, yet by its use the source of bad "butts" may be located. For instance, the water in the boiler may accidentally get too high, the alarm be sounded and perhaps 48 hours afterward defective ice is found. There would be no occasion to search far for the cause. The steam-flue cleaner is another device that is both a labor and fuel saver because the flue doors are not open while the cleaning is being done.

Pumps

The pumps need a careful examination, especially if steam driven. In all cases it will be necessary to determine what will be required to put both ends of the pump in first-class condition while the pump is working under normal conditions. If pumping from a well or stream and using a submerged foot valve, be sure to see that it will give no trouble when every gallon of water is needed in the plant. Do not take any chances and have cause to regret it before the season is over. Rig up a chain block and hoist it out into the clear. If the water valves are rubber and rough on the face, but not cracked, they can be used again by heating a smooth flat disk somewhat larger in diameter than the valves; then grasp the disk in both hands, pass it lightly over the hot disk and occasionally scrape off the burnt rubber on the disk. Continue until a flat surface is obtained. This requires a little practice with a few old valves, but it pays to do it.

Some of the above suggestions apply also to the ammonia pumps. Have as little clearance as possible between the plungers and the heads, also between the top of the valve disks and bonnets in order to avoid the pump becoming gas bound, as this will reduce its capacity because the compressed gas will expand when the plunger recedes and take up space in the cylinder that should be filled with rich liquor. In case, however, the pump should become gas bound, it is a good thing to have a connection between the poor liquor pipe and the pump suction from the absorber, with a valve between. By drawing some of the poor liquor directly into the pump the surplus gas will be absorbed in a few minutes.

Generator

If the generator has been closed for a few seasons it would be a good plan to open it because frequently the coils or tubes become incrustated from impurities in the aqua ammonia and consequently require a higher steam temperature to liberate the gas. The foregoing applies equally well to the dehydrator, exchanger and absorber.

Condensing Coils

If the condensing coils are of the atmospheric type, there will be very little to do, providing a test of the cooling water showed no leaks; with the inclosed double-tube type, however, it may be different by reason of sediment in the water adhering to the pipes. Hence, in order to get full benefit of the cooling water it is essential that they be clean and kept clean. This also applies to the absorber coils or tubes. The pipe conveying the liquid ammonia from the condensing coils to the expansion valve or collector should be run through the coolest part of the building in order to maintain the same temperature if possible as when it left the condensers. For every degree that the liquid is heated in passing from the condenser to the expansion valve it loses about $^1/_{400}$ or 0.25 of 1 per cent. of its effective heat-absorbing power. For this reason it is good practice to place a thermometer in the liquid pipe close to the expansion valve so that the engineer when passing can see at a glance whether he is maintaining the regular temperature on the high-pressure side. Should he find the temperature increasing he will at once know that one of two things must be done: either more cooling water must be supplied or the condenser coils need cleaning, and it will not be necessary to wait until the bath has gone up several points and then hunt all over the plant for the cause.

Freezing Tank and Coils

Suppose that the coils and bottom of the tank have not been cleaned for several years. This work should be done expeditiously because the coils should not be exposed to the atmosphere any longer than is absolutely required. After the tank is emptied, give it a thorough cleaning; be sure and include the can covers and timbers which they rest on to prevent any dirt dropping into the cans when they are filled with distilled water.

In the meantime have the top and bottom manifolds or headers disconnected, clean the flanges nicely and with a little oil on the bolts run the nuts over them. By this time the tank will be clean. Then see that the standards holding the coils are all right and also see that there is no trap in any of the pipes. This is very important. Blow out each coil separately with steam and test with brine, if the weather is cold, to about 300 lb. If a leak should develop, put in a new pipe; do not patch submerged coils unless in the case of an emergency. In case of extreme cold, finish one coil at a time and if there is compressed air, finish by blowing through each coil. The coils should be divided into sections with from two to four coils per section, according to the size of the tank. The section should be connected to a main line or header running the whole length of the bath. By this means a more even distribution of the expanded gas is obtained, and while this is not quite so important in the flooded system, yet it is of equal importance should one or more coils get clogged or spring a leak, because repairs can then be made without much loss, and if there is a valve on the top and the bottom of each coil, the defective coil can be cut out at once.

If the tank is made of steel it should be painted fully as far as the lowest water level, but before painting it must be thoroughly cleaned. As to painting coils, there are various opinions, but one thing is clear; if the coils are not thor-

oughly cleaned of rust the paint will not adhere, and if by oversight a few square inches are painted over rust, all the labor and material are not of much benefit.

The writer has personal knowledge of extra-heavy butt-weld bath coils that were in constant use for 10 years and never had an ounce of paint except the cheap stuff put on at the factory to prevent rusting while in transit. The coils stood a test of 300 lb. with only three leaks. The secret of the lasting qualities is, in the writer's judgment, due to their being submerged continually. In reconnecting, see that the nuts do not jamb into the body of the bolt before the flanges are properly tightened or there may be lots of worry for the man who has to crawl down to replace the bolt with too much body after the machine is started; above all, get the best rubber on the market for that part of the job.

Pipe and Fittings

Use nothing but extra-heavy lap-weld pipe on any part of the high-pressure side of the ammonia system; do not put up a single piece of pipe or nipple without looking through it for blisters. In using a pipe cutter, it frequently happens that it leaves not only a ragged edge but reduces the pipe area; hence every piece should be examined. Do not use old fittings on ammonia piping for two reasons: First, it costs half as much to take them off the pipe and clean them as new ones cost and the threads are never as sharp and smooth as on the new fittings. Do not use any thick pasty substance to make a joint as it will only be a question of time (and a short time at that) when the ammonia will penetrate this paste and a leak result. The writer has personally made thousands of joints and found that by having good threads on both pipe and fitting, using a little flake graphite with good oil and screwing up good and hard, iron to iron, a lasting job will be obtained.

Adjuncts

In addition to those mentioned for the boiler, an automatic poor-liquor regulator attached to the absorber is an excellent investment. It is installed under a guarantee and it does the work. This, in connection with a good ammonia-pump governor, leaves the engineer free to do something besides watch the absorber glass because several pounds variation in pressure either in the generator or absorber will require regulation or chance must be taken of a boil-over or flooding the absorber. On the other hand, if these parts can be relied upon, he will have ample time to devise ways and means of improving the plant that will soon repay the first cost. Another advantage to the engineer is to have a thermometer in the poor-liquor pipe leading from the cooling coils to the absorber, for the same reason that the thermometer would be inserted in the pipe leading to the expansion valve. A thermometer inserted in the feed pipe between the boiler-feed pump and the steam boiler is also a help to the engineer because he can see at a glance whether he is getting the best work out of the heater.

The general appearance of the plant should be made inviting, not only for the employees, but for the employer as well as visitors who may be invited to make a tour of inspection. While it is true that neither paint nor whitewash will make ice, yet a neatly kept engine and boiler room, with tool racks and fitting bins, lends a cheerfulness to the place; it is a credit to the man in charge and is more or less inspiring to all the help in the plant.

Properties of Carbon Dioxide

By F. B. W. Barker

Carbon dioxide (or carbon anhydride), often improperly called carbonic acid or carbonic-acid gas, is composed of one part carbon and two parts oxygen. It is the product of complete combustion of carbon and is always formed when carbon or any carbon compound is burned under conditions that afford an abundant supply of oxygen, and also during decay (slow combustion), fermentation and putrefaction of organic matter.

For refrigeration purposes, carbon dioxide is usually manufactured by decomposing marble dust ($Ca\,CO_3$) with hydrochloric acid. It is also manufactured to some extent as a byproduct in breweries, distilleries and in the calcination of lime and from other sources.

The gas from the retorts or other generating apparatus is confined in a gas tank before its process of liquefaction.

A plant almost identical in its main features with a carbonic anhydride refrigerating plant is used for the manufacture of liquid carbon dioxide. The cylinders or drums in which the carbon dioxide is stored and shipped have a capacity of 800 cu.in. and hold 20 lb. of the liquid.

As a refrigerating medium the value of carbon dioxide is due to its noncorroding action on any of the metals. That it cannot decompose during compression, and that liquid carbon dioxide is cheap, are other points in its favor as a refrigerating agent, as is also its lesser danger to respiration in case of leakage. It is claimed that air containing 8 per cent. of carbon dioxide can be inhaled with impunity, and it is particularly applicable for marine service and confined places on this account. Carbon dioxide is also neutral to meat, water, beer and other products subject to cold storage.

The cubic contents of the compressor may be considerably less as compared with machines using other refrigerating mediums, and the parts must be made stronger on account of the high pressure of the gas. The efficiency of a carbonic anhydride system is somewhat less than that of one using ammonia, due to the small latent heat available for effective refrigeration per pound of liquid circulated through the system. The theoretical coefficient of performance of ammonia is 13.2; that of carbonic anhydride is 11.4; its theoretical performance in a Carnot cycle is 13.6.

A number of practical tests published by Linde a few years ago led him to the compilation of the following table, which shows the excess of efficiency in percentages of the ammonia over and above that of the carbonic anhydride system, both working at different temperatures before the expansion valve, the temperature of the brine surrounding the expansion coil being 23 deg. F. in all cases:

Temperature before expansion valve,

54°, 65°, 72°, 84°, 90°.

Excess of efficiency of ammonia system,

17%, 23%, 31%, 47%, 101%.

As a leak of carbonic anhydride cannot be detected by its smell, considerable quantities can escape before it is noticeable; for this reason special care and supervision are required to prevent leaks in the system when it is in service.

At atmospheric pressure liquid carbonic anhydride has a specific gravity of 1.529 and becomes liquid at a temperature of — 124 deg. F. At 32 deg. it is liquefied at a pressure of 540 lb., and at this temperature its specific weight is 0.93, while at 42 deg. F. it is 0.883; at 47 deg., 0.853; at 65 deg. F., 0.7385, and at 86 deg. F., 0.60 (water equals 1). At 32 deg. F. its latent heat of evaporation is 102.35 B.t.u. per pound of liquid.

From the foregoing it appears that enormous pressure is required to liquefy the gas; this pressure varies in amount in different climates from 750 lb. with water at 50 deg. F., to 1125 lb. with water at 84 deg. F. Another feature worthy of notice, due to the nonpoisonous nature of the gas, is that it is possible to introduce a safety valve, which is a welcome addition to any system employing high pressures.

Once a practicable form of superheater had been evolved, the growth in popularity of the locomotive using superheated steam was inevitable. Had the compound locomotive not made such a bold bid for popularity, superheat would have come into its own many years ago. The latest notable engine of this type is a Pennsylvania Railroad Mallet, with four 27x28-in. cylinders and a boiler pressure of 160 lb.—*Scientific American.*

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. and Treas. ROB'T MCKEAN, Sec'y.
505 Pearl Street, New York.
122 South Michigan Boulevard, Chicago.
6 Bouverie Street, London, E. C.
Unter den Linden 71—Berlin, N. W. 7.

Correspondence suitable for the columns of POWER solicited and paid for. Name and address of correspondents must be given—not necessarily for publication.

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Subscribers in Great Britain, Europe and the British Colonies in the Eastern Hemisphere may send their subscriptions to the London Office. Price 21 Shillings.

Entered as second class matter, December 20, 1910, at the post office at New York, New York, under the Act of March 3, 1879.

Cable address, "POWPUB," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

Of this issue 29,500 copies are printed.

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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POWER

The Engineering Congress

Preparations for the Panama Pacific Exposition, which is to be held in San Francisco in 1915 to commemorate the completion of the Panama Canal, are now in progress. From present indications, it will mark in a fitting manner the consummation of this great undertaking which the United States will have had the distinction of carrying through.

Aside from the commercial aspect of the canal, it represents one of the greatest engineering feats ever undertaken. For this reason it has been suggested that the several leading engineering societies of this country unite in taking official cognizance of the fact. To this end tentative plans have been formulated for holding a great engineering congress in conjunction with the exposition in September, 1915.

A preliminary meeting of delegates from the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Pacific Coast Gas Association, the American Society for Testing Materials, the Society of Naval Architects and Marine Engineers, the Mining and Metallurgical Society of America, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the Technical Society of the Pacific Coast was held on Jan. 15 of this year and questions relating to an engineering congress were carefully considered.

As a result, it was decided that the delegates recommend to their respective societies that the annual meeting of each society be held in San Francisco in September, 1915; and that each society represented invite as its guests the corresponding engineering societies abroad. Thus the congress would be made international in scope.

Furthermore, it was planned that, although each society is to proceed independently, there shall be arranged joint meetings at which papers upon kindred subjects shall be read. The exposition authorities have agreed to furnish a suitable auditorium for the purpose and already several of the societies have acted upon the suggestions of their delegates.

The importance of the congress cannot be too strongly emphasized, and all those who have the advancement of engineering at heart should use every effort to make it a success. By having the congress international in character, as suggested, an opportunity will be afforded for clearing up many of the inconsistencies in engineering methods and practice which are now so troublesome when attempting to reduce things to a standard basis for comparison.

One of Many

A correspondent writes us that he "positively knows engineers do not get their dues." In other words, he means that he is not getting as much for his labor as he is worth; that his efforts are not appreciated, and that putting in long hours for small pay is a losing game with some employers.

We know this engineer; he is not a mere starter and stopper, but is the chief of a well known office-building power plant. He buys all supplies for the building, and, although this item is added to the operating and maintenance account, the cost for operating this plant for the past year was one and sixty-eight one-hundredths cents per kilowatt-hour. Not bad!

But his employers are not satisfied with the showing of their engineer, who, in looking after their interests, puts in from twelve to fifteen hours daily at the plant. The men with the manicured finger nails, filled-out vests and slick ways are not satisfied with getting their heat, power and light for a sum far less than the light alone could be purchased from a central station.

And so they want the chief engineer to get along with two assistants instead of three for the twenty-four hours' service, three hundred and sixty-five days in the year. They want the chief engineer

with his executive ability to become a common wiper about the plant, a general repair man and jack-of-all-trades.

And why? Simply because they are greedy; they will not credit to the power plant a sum commensurate with the plant service rendered.

It looks as if the Taylor system was about to be applied; that is, work a man like a machine and expect him to stand the grind equally well.

It cannot be done.

This chief engineer admits that such closeness on the part of the officials of his company makes his position far from satisfactory, and he shows the proper spirit when he says, "It is discouraging work, but so long as I am here, I shall dig in and do more and better work, whenever I can and wherever I can."

This attitude has had much to do with this engineer's success. It will have much to do with his future. While his present employer may be willing to lose an efficient chief engineer and save the wage of one assistant, there are those who are looking for this chief engineer to operate their plant, but do not know where to find him. More, they are willing to employ enough men to obtain effective supervision and would not permit a chief to do an oiler's work.

We predict that this engineer will, ere long, be called to fill a better and more responsible position.

Power Station Records

Power-station records are a necessity if it is desired either to obtain the unit cost of the power or to study plant economies. In manufacturing plants, power is an item of operating expense and hence a positive factor in the final cost of the manufactured product. In plants furnishing heat, light and power, the unit cost becomes the basis of the selling price. This knowledge while not as important in the operation of small isolated plants as in connection with central power stations, is even here essential to an analysis of the costs. Many a plant is operated, however, with no attempt to differentiate the cost of running the power department, dependence being placed upon the ledger balance to determine whether the establishment as a whole is profitable. If this is the case, but little further attention is usually paid to the power costs.

This information is valuable when the question of continuing the operation of the small plant or taking current from the central station is under consideration. The management is justified in changing to central-station power, other things being equal, if it may be obtained continuously at a cheaper rate than the manufacturing cost of the power in the small isolated plant. If this cost is not definitely known, there is no way of telling which arrangement is actually the cheaper.

The importance of this information is quite generally understood by efficient plant managers, but it is not always easy to obtain it. The principle is very simple. The cost of the coal, supplies, labor and the fixed charges for a definite period divided by the total power output for the same period will give a value for the unit cost. This involves the making and keeping of various records in the power plant.

If the load is entirely electrical, the value of the total work output may readily be obtained either by reading the integrating wattmeter or by averages obtained from consecutive readings of the ammeters and voltmeters. If the output is not entirely electrical, the procedure is usually more complicated. In each case, however, it will be possible to take such measurements and keep such records as will enable one to ascertain the total work output.

The operating expenses are made up of the cost of the coal or other fuel, water, supplies, repairs, labor, office expense and the fixed charges, which items must be determined separately and added together to make the total for a given period.

The duration of the period is a matter of some importance. It must neither be too short nor too long; a month would seem to be about right. This is short enough for but slight climatic changes and long enough to get a fairly representative result.

The plant test is another method of obtaining the unit cost. In addition to yielding the desired information concerning the cost of power, a large amount of information in connection with plant economies would be obtained in this manner. This method involves a special arrangement of apparatus and the making and recording of a considerable number of observations. The principle is necessarily the same as that previously explained. The total work output for a limited period, usually short (twelve to twenty-four hours), and the total operating expenses for the same period must be obtained. This means that the coal and water consumption must be accurately measured for the duration of the period. A number of such representative tests taken within a comparatively short interval may be averaged to obtain the final result.

The records made in connection with the ordinary operation of the plant are largely a matter of judgment and personal convenience. The problem is what records are useful in each particular instance, rather than how many. The instruments of measurement available are automatic coal weighers, water meters, steam-flow meters, carbon-dioxide meters, smoke recorders, thermometers, pyrometers, tachometers, calorimeters, etc. All of these records are not necessary in any one plant or even desirable unless the plant is operated on the basis of a continual test.

The making and keeping of power-station records is one thing and the interpretation of them is another, as the record itself has no virtue unless it is used and profit made of it; it must be studied and interpreted and the conclusions arrived at must be carefully and thoughtfully applied.

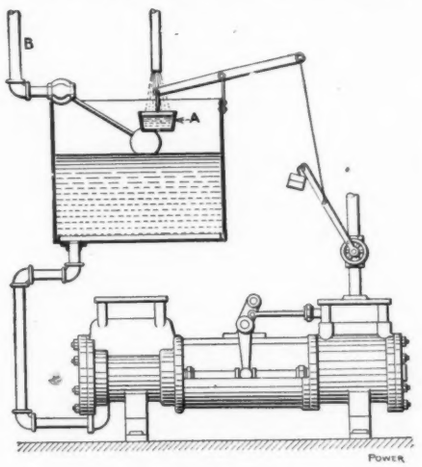
In our attempt to ward off from Arthur C. Davis, of the engineering department of the Equitable Building, the storm of criticism which was being directed against him for having, as it was asserted, neglected to send in an alarm and trying to extinguish the fire with his own force, we did the gentleman an unintentional wrong by questioning how the chief engineer of a plant like that of the Equitable happened to be on hand at that untimely hour unless he had an intimation of trouble. It develops that Mr. Davis is not the chief, as all the papers were calling him, but the night engineer. He was on duty, as he should have been, and did an engineer's duty under exceptionally trying circumstances to prevent the bursting of boilers from adding to the horror of the catastrophe. We regret that even by implication we should have called his conduct into question.

Readers with Something to Say

A letter good enough to print will be paid for. Ideas, not mere words, wanted

Automatic Pump Regulator

The accompanying figure shows an arrangement which I have devised to automatically keep the storage tank on the roof full. The small pail *A* controls the steam valve of the pump. The overflow from the tank empties into the pail, causing the valve to close. A small hole



AUTOMATIC PUMP CONTROL SCHEME

in the bottom of the pail allows the water to drain out. When no overflow is falling into the pail the water drains out and the weight on the valve lever over-balances the weight of the pail, opens the valve and starts the pump.

The makeup water is automatically supplied by the pipe *B*, which is controlled by a float valve, as shown.

E. T. LEHMAN.

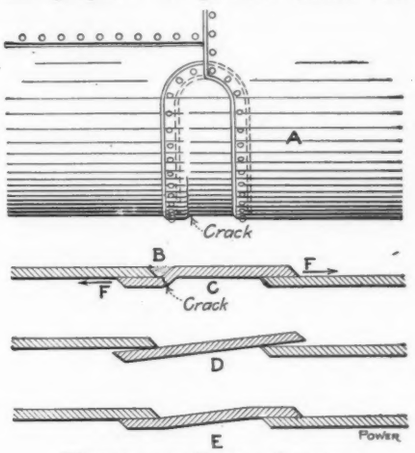
Chicago, Ill.

Patch Cracked

One of our boilers had a patch on the bottom, extending about half way of the circumference, as shown at *A*. This was an offset patch, as shown at *B* and—evidently due to the mud settling in the V-shaped hollow, as indicated at *B*—got overheated at that point probably many times before the plate cracked.

All of a sudden one of the firemen noticed steam issuing from the boiler setting, and by the time the fire was pulled, the ashes in the back end of the boiler were soaked to a paste. A light was fastened to the end of a long stick and held under the boiler, when it was discovered that a stream of water was issuing from the shell of the boiler. When the boiler was cooled down sufficiently for a man to get inside the brickwork, it was found that the patch was cracked, in the offset, as indicated at *C*.

This patch was ripped off and a new one cut and rolled to the required radius, but not offset, as shown at *D*. After scarfing the patch it was bolted to the boiler, four holes having been drilled for that purpose. A gasoline burner was



WHERE THE PATCH CRACKED

used to heat the edges. After it was fitted, holes were scribed to match the holes in the boiler; the patch was then removed, the holes drilled and it was then riveted in place, as shown at *E*.

Making a straight patch obviates the hinge feature in its offset part. The expansion tends to straighten the plate, as indicated by the arrows at *F*. The point where the crack developed is also shown in this view.

Using the straight patch lessens the tendency of mud to settle on account of a more gradual slope to the plate.

V. T. KROPIDLODLOWSKI.

Winona, Minn.

Improved Turbine Steam Valve Spindle

A great fault with the nozzle valves of the electric-control type of steam turbine is that the pistons will work loose from the valve spindles.

The brass nut which fastens the piston to the spindle will either unscrew and drop the spindle through the piston, thereby closing the valve or, in the case of the latter pattern of pistons and spindles, where keys and keyways are provided to prevent this trouble, the threads of the nut and often of the spindle will strip, resulting either in costly repairs or putting a valve out of commission when it may be badly needed.

This defect can be prevented by remodeling the spindle *A*, shown herewith, and making a new part *B* to which the valve disk is to be secured. The piston is then put on the spindle in the usual manner; afterward, drilling and riveting it as at *DD*. The spindle can then be put in place in the valve-chest bonnet, and the part *B* screwed on, drilled and riveted as at *E*.

WILFRED E. BERTRAND.

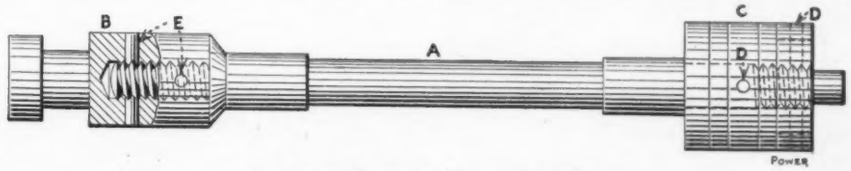
Philadelphia, Penn.

Pumping Engine Speed Limit Device

A horizontal cross-compound Corliss type of pumping engine pumping to a reservoir against a practically constant head had a speed-changing device applied to the governor to regulate the supply to suit the demand. The governor controlled the cutoff for the high-pressure cylinder while the cutoff for the low-pressure cylinder was regulated by hand.

This arrangement worked all right within certain limits, but when the demand was light and the engine was run at low speeds the governor would often take to surging, and on one occasion the belt ran off and the safety cams failed to work. Of course, the engine started to race—and so did the engineer.

This engine was equipped with a well known type of stop which closes the throttle when the speed reaches a predetermined point. In this instance, the engine stop operated, sounding an alarm; but it was then discovered that it was possible to tighten the packing on the throttle-valve stems to such an extent as



IMPROVED TURBINE VALVE SPINDLE

to make this form of engine stop almost inoperative.

The increase in load due to speeding up the pump was sufficient to keep the

speed from reaching a dangerous point before the throttle could be closed enough to control the engine.

Steadier and more satisfactory operation was afterward had by putting a positive, hand-adjusted cutoff arrangement on the high-pressure valve gear, discarding the governor altogether, and keeping the engine stop in good operating condition to act as a speed limit.

WILLIAM E. FRANCIS.

Lynn, Mass.

Troublesome Heating System Pump

In 1906 I took charge of a plant which included a 60-in. by 16-ft. return-tubular boiler and a 5¼ and 3½ by 6-in. piston-packed duplex steam pump. The manager assured me that the plant was to be considered as the last word in factory construction, steam heating, etc., but I viewed the future with misgivings after I had wrestled with the steam-heating end of it for a week.

The architect had very carefully designed a hole about 6x7x4 ft. deep, and down in that hole the receiver and pump had been placed. The pump was set against one side of the pit wall and in order to pack the pump it was necessary to recline on one side, wedged between the pump and the wall.

No valves were placed in any of the return pipes discharging into the receiver, so that, when the plunger packing gave out, the new packing had to be put in while the contents of the factory return pipes poured over the hands of the unfortunate victim. In addition to this, the bucket traps on the kilns gave a double-barrelled discharge of more hot water about once every three minutes.

Next, the brass lining on the water end of one side tore loose from its moorings, and trotted up and down with the plunger until it brought up against the covers, blanking the port and staving up the end of lining.

The antics of that pump would make our friend "Potblyn's" pump look like a Sunday-school superintendent. Of course, a new bushing had to be procured and when it arrived I discovered that it was a full $\frac{1}{32}$ in. too small. I called up the pump makers and was informed that they depended on the beading of the ends to hold the bushing in place. The manager, who was aware of all the facts in the case, began to hint that he preferred the word of the pump makers to mine, and I saw that the best thing for me to do would be to rely on my own resources, and prove the makers wrong.

I took a piece of galvanized iron and bent it around the outside of the bushing, applied white lead to it and pulled both snugly into place with a long threaded bolt, after which I beaded it over. All this was done while deluged with hot water.

The brass suction and discharge valves, four of which were on each deck, were made so thin that after a couple of months' use they dished up all round, bearing only at the center.

I made a pattern and got eight new bronze valves of the same size as the original ones, but reinforced with little webs, radiating from the center, so that bending would be impossible in the future.

The next thing to receive attention was the steam valves. One side of the pump always cushioned very nicely but the other side traveled until the spool struck the stuffing-boxes. I found one of the valves longer than the other and a difference of ⅛ in. in the thickness of the valve nuts which in this case were pieces of iron about 2 in. long and 1⅛ in. wide. One was ½ in., the other ⅝ in. thick. I made the valve short enough to just reach from the extreme edge of the admission port at one end to the extreme end at the other.

Right here, I made a radical departure from accepted practice in pump construction. I made the new nuts thick enough to just fill the slot in the back of the slide valves, so that there was none of that famous "lost motion" except what the wear in the valve motion supplies.

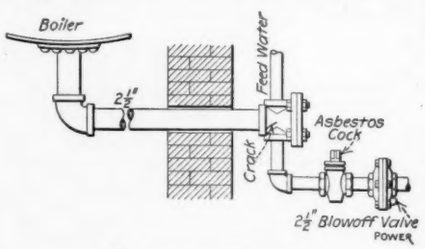
Brass bushings in the links, the removal of the receiver out of the hole altogether, placing the pump on a neat concrete bed, made in the middle of the pit and a foot higher than formerly, were changes I made after the first winter, and "Potblyn" himself would be satisfied with the smooth running of our old pump, now that the causes that bewitched her are removed.

GEORGE HILTON.

Hamilton, Ont., Can.

Fitting Fractured

While working on a job last fall, an incident occurred in a plant which contained four return-tubular boilers, the



FRACTURED FITTING

safety valves of which were set to blow at 100 lb. pressure. These boilers were connected in the rear to a cross connection. An asbestos-packed blowoff cock next to the boiler was always left open. Connected to this was a second blowoff valve.

On looking for the cause of a small leak, I found the blowoff cross cracked as shown in the accompanying sketch. The boiler carried 100 lb. of steam.

I believe that the fireman in blowing down the boiler closed the blowoff valve too suddenly and caused a water-hammer which cracked the fitting.

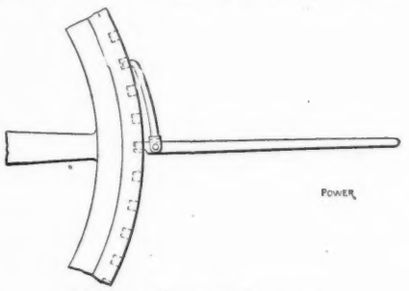
HUGH MCDONALD.

Oak Park, Ill.

Starting Bar

Having had considerable trouble with engine-bars slipping and wearing the slots out of shape, I made the bar shown in the sketch, and it has proved very effective.

It can be used on any engine or compressor if the flywheel is provided with



STARTING BAR IN POSITION

slots; it will not slip, for the harder the pull, the tighter it grips. It fills a long-felt want in our plant.

The handle may be made short and fitted with a suitable piece of pipe if preferred.

H. H. DELBERT.

Titusville, Penn.

A Reducing Valve Repair

A reducing valve on a pipe line supplying steam to an engine at 100 lb. pressure gave trouble. In the same plant there were a number of small steam engines, heaters, etc., supplied from two boilers working at 60 lb. pressure. The idea of the reducing valve was to relieve the other two boilers, should there be a heavy demand for steam. The valve consisted of a valve and piston controlled by a small valve which could be adjusted to blow off at any desired pressure.

The valve had been in place for some time, but was not working. This was rather troublesome as there might be a light load on the engine during the day, and a heavy demand for steam from the other two boilers. The piston of the main valve was grooved for a ring, but the ring had been removed. The result was that the main valve would not lift, should the small valve open and admit steam, as the steam passed the piston without moving it.

I was told that with the ring in place the valve would open all right, but that it would open too far and refuse to close, thus causing a sudden rush of steam in-

to the other pipes, resulting in the other boilers blowing off, and the steam supply taken from the engine.

I decided that this action of the valve was due to lack of drainage of the space under the piston—the space would fill with water—and that when the small valve opened the steam would lift the piston all right but the space would then fill with condensed water. When the small valve closed there would be practically no escape for the water; this would account for the valve remaining open.

Acting on this idea, I had a new ring made, and, instead of fitting the ends as closely as possible, I left them a short distance apart so that any water could readily escape; this also kept the piston from rising too quickly. This seemed to have been the matter, as the valve gave no further trouble; it opened and closed gently at any desired pressure.

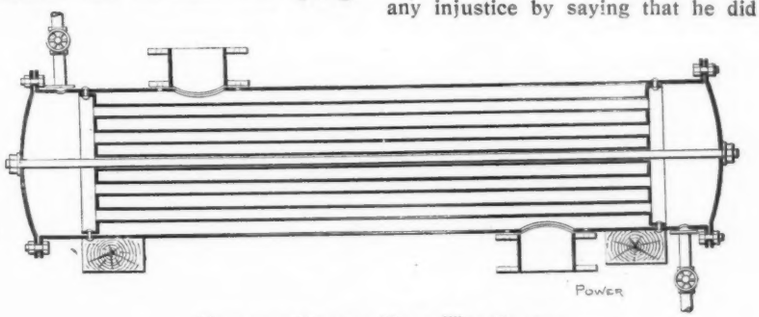
W. BURNS.

Govan, Scotland.

Braced Heater Heads

Some time ago I was employed at a small boiler shop where a home-made heater was used. The joints on the heads could not be kept tight with different kinds of gaskets, although the faces were forced off true.

I decided that the head was springing, as it was made of 5/16-in. boiler plate and was about 30 in. in diameter. The heads were bumped slightly. I put a stay-bolt through the center tube with a lead washer under each nut on the heads. This cured the trouble. The heater was used with a feed-water pressure of about 125 lb. per square inch.



HOW THE HEATER HEAD WAS BRACED

LEO GRANDMONTAGNE.

Youngstown, Ohio.

Relation between Employer and Engineer

For the employer there is this to be said, he has the many cares and responsibilities that go with any business on his mind all of the time and he may be excused if he forgets for a time his employees and their troubles. On the other hand, to get business success he must depend largely upon his employees, and the shrewd manager realizes this.

In the case of the central-station companies the power house and the man in charge are all important, but in many other organizations, while the power plant is a necessary part, it does not always receive proper consideration.

There are among engineers, as there are among other classes of workmen, those to whom it would be impossible for any employer to make any advances of a nature favorable to the employee which would not be viewed with suspicion, for they would be so fearful of there being "a string to it" that the favor would be unappreciated. For these there is not much hope of making their relations with their employers any more pleasant.

There is a large number of men, however, who wish to do the right thing and with such as these it will pay the employers to keep in closer touch not only by simply using them well and not bothering them, but also by showing them that some interest is being taken in their work.

I know of an instance where a small central-station company had a very difficult power plant to operate, and even though it was new, for the first year and a half there were frequent shutdowns and accidents. Having hired a new engineer who took great interest in the business from the start, things began to look brighter for the company.

Now, I do not wish to do the manager any injustice by saying that he did not appreciate the improved condition of things, for undoubtedly he did; not, however, because it was better for the company but because it relieved him of some personal responsibility.

When the ambitious engineer had the plant running on a good operating basis he rarely ever saw the manager at the plant and if he went to the office he found that his employer seemed to be ready to discuss almost anything else. Even when, after an increase of business, the load became so great as to make it a question whether the machinery would pull it, the manager showed no alarm nor would he bring himself to look into the matter with the engineer, thus making the employee feel that he was wasting his energy when the man higher up did not seem interested. He felt the lack of that support which would have strengthened his interest and kept him contented with his position.

This man had proved by several years' good work that he was the right man for the place and any far-seeing manager would have discovered that fact. Instead, the manager in this case forced the engineer to resign in disgust because of the indifference which he displayed.

How often one hears of a position as engineer of which it is said: "The job pays well, but they are hard people to work for." This may not mean that they are continually hounding their engineers, but that they hold them at such a distance that there is no bond of sympathy and that when something serious does happen, the employee is given no chance to explain and either leaves or is discharged.

Relationship is a great factor in making faithful employees and when it is properly followed it makes up for years of system and rules in maintaining efficiency. In all cases it is first necessary to get a good man and then, to get good work from him, to use him well.

G. H. KIMBALL.

East Dedham, Mass.

See the Hump

The hump which appears in the expansion line of the accompanying diagrams seems to be due to the indicator itself. I took seven sets of diagrams, five with one indicator and two with another. Of the first five sets, four showed the hump and one did not. Neither of the two sets taken by the second indicator showed the hump.

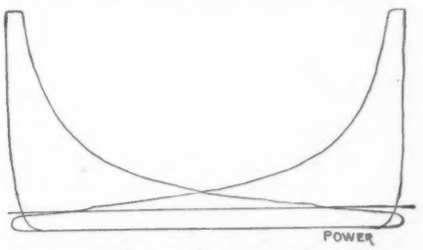


DIAGRAM HAVING HUMP IN EXPANSION LINE

What is your explanation?

PHIL LIGHTE.

Woodhaven, N. Y.

Graphite for Hot Bearing

A few days ago I paid a visit to my friend Sam who runs a large pumping station.

I noticed as I entered that there seemed to be quite a bit of excitement going on and all hands were congregated about the crankshaft of one of the 40,000,000-gal. engines.

The usual paraphernalia most in evidence where there is a hot bearing were lying around accompanied by a 1¼-in. water hose. The hose was being applied with indifferent success.

A crackling, sizzling sound came from the bearing, which was steaming profuse-

ly, and no amount of water seemed to have any effect; the shaft and quarter boxes were cold. But the face of the drag-crank was about the hottest thing I ever saw.

Sam said the engine had been on for about two hours before it started to heat up. He had tried to cool it off by dumping buckets of fresh oil into the handhole, but this only made it smoke worse. They use a light, cheap oil and a gravity-oiling system, the oil costing about $75 per 1000 hp. per month, which does not speak well for his choice of oil. He tried to get grease to the bearing but could not, so he applied his trusty hose.

Sam has great faith in water, but he would lose it mighty quick if he were driving generators instead of pumps.

After he had shut down and taken the cap off and the top shell out, we found that the face of the crank had worn tightly against the frame and the oil could not get to it.

We tried to push it over by setting the quarter boxes in, but the crankpin held it. We could not slide the bottom shell out, as the flywheel was too close. To raise the crankshaft and chip oil grooves in the bottom shell would mean a two days' job and the unit could not be spared that long. So Sam chipped oil grooves in the cap and top shell and put them and the other stuff on again and started up.

Ten minutes later he had the hose going again and the steam and oil were sizzling as merrily as ever.

"Sam," I said, "suppose you take the hose out—it isn't doing any good—and pour graphite and cylinder oil down that hole."

Sam came back with a snort, saying that if that was all I knew it would be better for me to get back to the power house and my toy engines. "Graphite," he said, "was good stuff to put on water gaskets and to make pipe dope of, but for hot bearings, cold bearings or anything that moved, it was nix."

He had read an advertisement which said graphite was "grand" for bearings and he said he was foolish enough to try some on a little 20-hp. vertical engine used for driving a circulating pump, whereupon the box got so hot that if he had not used the hose it would have been a case of pouring a box, or perhaps a broken crankshaft. Out in the boiler house, under the vise bench, I found an old teapot about half full of the kind of graphite used in foundries, which had about as much grit in it as graphite.

I had just bought a 5-lb. tin of graphite, so I went over to the power plant and brought it back, finally persuading Sam to let me try it on his bearing.

It was Hobson's choice with him as he had shut down again. He turned the engine over slowly while I poured the graphite into the oil groove that had been cut in the top shell and cap, pouring about a teaspoonful of graphite and a little cylinder oil for about every 10 revolutions. We kept this up for about half an hour and then speeded the engine up to about 25 r.p.m.; its full speed is 35½ r.p.m.

I continued putting a little graphite and a lot of cylinder oil down the groove for an hour longer and left half a can with him. At that time the bearing was pretty hot, but it seemed to stay at the same temperature, and so I took that as a sign that it would cool off in an hour or so.

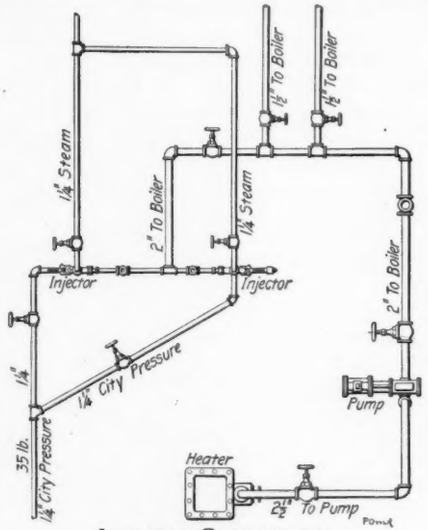
I visited Sam the next day and found the box about 110 deg. F., and there were two cans of good graphite in the supply cupboard.

CHARLES BENNETT.

Chicago, Ill.

Will the Injector Work?

The accompanying illustration shows the arrangement of two injectors and a boiler-feed pump. I would like to know



INJECTOR CONNECTIONS

if both injectors will work at the same time in case the boiler-feed pump failed. One injector will not supply both boilers.

J. L. BROUSE.

Elyria, Ohio.

Grinding Hard Rubber Valves

When truing up hard-rubber pump valves with emery cloth the surface soon glosses over.

My present arrangement for truing them up is to use two pieces of broken grindstone about 10x8x2½ in. in size, in which two of the flat surfaces were made perfectly true by abrasion, wetting and rubbing them together until each piece has a perfectly clean, true surface.

When about to grind the valves, wet both pieces and bring the true surfaces together and rub slightly to make each surface sharp and clean and deposit fine sand on the surface. Then rub the hard valve over the stones until a true surface has been obtained. As soon as the floating sand has been used or the pores seem to close with the grinding substance of the valve, rub the stones together again to clean them.

GEORGE B. MICHAEL.

Dayton, Ohio.

Temperatures in Engine and Boiler Rooms

I have observed at this time of year that great losses occur in engine and boiler rooms that ought to be avoided. It is surprisingly common to see engine and boiler rooms with windows and doors open on days when the temperature is anywhere from 30 deg. down to zero weather, sometimes with a cold wind blowing right through on the cylinders of the large engines and on the walls of the boiler settings.

Where the practice exists, it is because the men in charge have never thought of making a simple calculation of the effect of temperatures on the radiation of heat. In one plant of which I had charge I made a practice of going around and closing the windows and doors on cold days for two or three days, soon finding that in a short time someone would raise them again.

Finally, one day as an assistant was raising the window near the cylinders of a tandem-compound engine, through which the cold air would blow on the lagging of the cylinders, I asked him if he did not realize that all the air thus admitted to the engine and boiler rooms was being raised in temperature at least 30 deg. I then told him to make a calculation with me to determine what this radiation of heat meant. I explained that the amount of heat radiated depended mainly on the difference in temperature of the heated body and the surrounding air.

After going over the matter with him, it was not necessary to advise care in this particular again; he was much surprised at the result of our calculations.

I then explained to all the men that the only object in ventilating an engine and a boiler room was to keep them at a comfortable temperature, and that in summer to favor the bearings when necessary it is desirable to keep the engine room as cool as possible. In winter there is no fear for the bearings; the rooms should be kept well warmed to avoid excessive condensation in pipes and cylinders, and in the boiler room to avoid radiation of heat as much as possible from the boilers and settings.

Of course, insulation assists in this very much, but it is not claimed that the most careful insulation prevents this loss. The amount of these losses, however, will vary according to the temperature differences between the air in the room and the heated body.

WILLIAM WESTERFIELD.

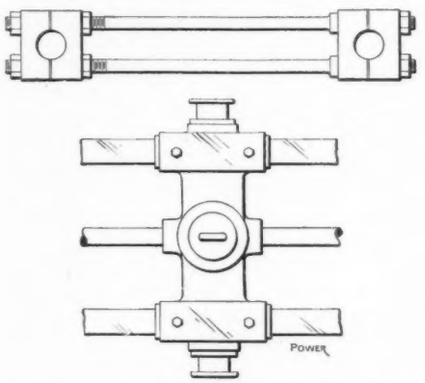
Lincoln, Neb.

Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

Knocking in Air Compressor

In reply to Frank Richards' criticism in the Jan. 30 issue, I would say that the knock referred to does not occur near midstroke but when the cranks are passing the centers. This is due entirely to the wear and take-up of the side rods. The accompanying figure shows a construction in which the builders provided threaded rods so that they may be adjusted. When this style of machine



DETAIL OF CROSSHEAD AND CONNECTING RODS

gets out of true much friction is caused. I have seen a balance-wheel key worked loose by this trouble.

Mr. Richards is mistaken when he says that a machine can be run with much variation in the length of the side rods.

C. R. MCGAHEY.

Baltimore, Md.

Engine Load Not Equalized

The unequal load trouble described in the Jan. 23 issue is due to the late cutoff in the low-pressure cylinder. The cutoff in this cylinder should be shortened; this will raise the receiver pressure and put more work on the low-pressure side.

From the appearance of the low-pressure diagram it would seem as though this were an engine running noncondensing which was designed to run condensing. To take the loop out of the low-pressure diagram it will be necessary to do one of the following things: attach a condenser, increase the load on the engine, reduce the steam pressure, or reduce the number of revolutions.

J. K. MCINTYRE.

Newburgh, N. Y.

If Mr. Gordon will shorten the cutoff on the low-pressure cylinder the load on this cylinder will increase and become less on the high-pressure cylinder. This change of load comes from the shorter cutoff giving a higher receiver pressure, and thus more back pressure in the high-pressure cylinder; less power is then developed in the high and more in the low.

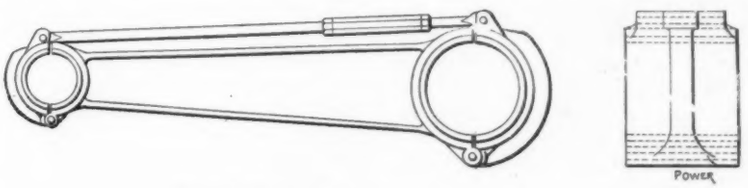
JOHN WALLACE.

Syracuse, N. Y.

Connecting Rod Ends

J. A. Levy's article on "Connecting Rod Ends," in the issue of Jan. 30, is of considerable interest. Though perhaps outside the scope he intended, it would have been interesting to have noted the different types of gas-engine rods as well. There is one make of connecting-rod for such work that I have never seen illustrated outside the maker's catalog. The sketch herewith shows the principle of the rod very well.

The outer parts of the rod ends are hinged below and pulled together at the top with a sleeve nut shown on top. The piston end is brass lined while the large crank end is babbitt lined. With the rod properly designed the pressures at the ends are always in correct relation so that when one end is adjusted for proper running the other is also. This is a great advantage, particularly in gas-engine work, where the boxing in the piston is very hard to get at for adjusting.



CONNECTING ROD WITH HINGED ENDS

In assembling the engine it was the custom to slip the rod into the piston, force in the pin and then the piston and rod were erected in the engine. The large end opened wide enough to slip over the crankpin readily. In this respect it has no advantage over the rod with a solid end in the piston, but it is superior in respect to its ready adjustment.

M. W. PULLEN.

Boston, Mass.

In regard to J. A. Levy's article pertaining to connecting-rod ends, in the Jan. 30 issue, I would say that from his statement in the last paragraph we are to believe that one type is as good as another; that it is only a matter of individual taste as to which type is selected.

Admitting that each type shown represents a great number in use giving entire (?) satisfaction to the users, it does not necessarily mean that all are alike, as there are many engineers, owners, etc., using machinery who have come in contact with one style only; they do not know whether anything else is better.

Referring to Figs. 5 and 6 of his article, Mr. Levy says these are mostly used on center-crank engines. This is because they are employed extensively by steamship-engine builders, and are therefore termed "marine ends."

I know of one company which employs this type on all of its engines—traction, portable and stationary. One great advantage of this type is that by taking out the proper number of shims the brasses can be brought together so rigidly that they are "locked," as it were, and yet, the bore is just "an easy fit" on the pin, whereas with other types, if this "locking" were attempted, the pin would be clamped until it would be impossible for the engine to operate.

With the marine end there is never a question of new brasses; only a small quantity of good babbitt is needed occasionally, and enough common sense with which to apply it.

LLOYD V. BEETS.

Nashville, Tenn.

Another Dynamiting Case

I was much interested in the letter, "Dynamite for Removing Pinion from Shaft" which appeared in the Jan. 30 issue, because of an experience I once had with dynamite.

Our problem was to remove two wheels

from a car axle from which we wished to turn a shaft for an electric mine locomotive. The first wheel was heated and then forced off with two screw jacks placed between the two wheels, but the other gave us trouble. After some discussion dynamite was resorted to in the following manner:

A short stump of tree sawed square at both ends, about 18 in. in diameter and 2 ft. long, was placed on end in an out-of-the-way place. The axle was placed on this and also stood on end. As the axle extended beyond the wheels about 8 in. to form bearings, there was room enough to shoot the wheel downward and off. Two sticks of dynamite were placed on the wheel, one on either side of the shaft, the shot was fired, and the wheel came off; but the shaft broke at the upper end, even with the shoulder formed by turning down for the bearing. However, the shaft was long enough for our purpose as the axle was from a car of a standard-gage road and the locomotive was for a narrow-gage mine road.

M. A. HANSEN.

Richfield, Utah.

Wanted: Engineer of Pleasant Disposition

I believe Mr. Morton is altogether wrong in his definition of "pleasant-disposition engineers." For the life of me I cannot see that an engineer with a pleasant disposition need necessarily be backboneless, brainless, a coward, a knownothing, etc., as suggested by Mr. Morton.

An engineer's greatest asset is a disposition to be calm and pleasant under trying or adverse circumstances. Subordinates have no respect for a surly superior, although they may fear his usually unjust and caustic remarks.

JOHN THORN.

Toronto, Ont.

License Laws of Massachusetts and Ohio Contrasted

The interesting article by Joseph King in the Jan. 23 issue on "Examiners and License Laws" is one of the many recently published which take a fling at the Massachusetts license law and its examining force.

In Ohio we have a law and an examining force, and the contrast between the two laws shows everything in favor of the Massachusetts statute. In the latter state the provisions of the law are carried out in spirit as well as in letter, and the examinations, as a general thing, are thorough and to the point, sifting and weeding out the incompetents. The oral form of examination gives the examiner an opportunity to size up the applicant, and with the aid of the large-size models a very thorough and practical examination can be made.

On the other hand, the license law of Ohio is not as efficacious. The form of examination is the coveted written one which so many of the men in Massachusetts would like to have. With this form, however, the examining force does not have a chance to estimate the man's personality and mental make-up as thoroughly as they would with the oral form. Another point against this form of examination is the fact that an applicant can be "loaded," as the examination questions are printed and not changed for each new set of applicants.

Some day the people of Ohio are going to wake up and send a carload of men down to Massachusetts to see how business is transacted there, and how the laws are enforced.

I will say that the wage condition in our state is somewhat improved since our law was passed.

ORRIN C. WERNER.

Kent, Ohio.

The Management's View

The foreword in POWER of Jan. 23 is one of the truest things ever published. It is a regrettable fact that a large percentage of employers fail to see just why a man in charge of a power plant, even only a small one, should be possessed of any special knowledge of power-plant apparatus, to secure economical results. This ignorance seems to be almost universal, and it is not confined exclusively to employers; there are numerous engineers (?) in every community who enjoy the same misbelief.

Within sight of the plant where I am employed is a small factory where I worked over 10 years ago. I installed a new boiler and small Corliss engine there, and as soon as everything was operating nicely, I was informed by the management that, since things were running so smoothly, it was not worth so much to run the plant and that a cut from $2.25 a day to $2 would be made; that it was not business to pay the engineer much more than the superintendent—he got $1.75 per day.

I stepped out. A man took my place who was a so called engineer while I was still in the country school, and he accepted $1.75 per day.

Just previous to his retirement a few months ago, this engineer bragged that during the time he had run the plant he had never seen the valves of the engine or the inside of the cylinder and had never applied the indicator to the engine; neither had he been inside of the boiler, either to examine it or to wash it thoroughly.

He cut out the exhaust-heating system which I installed and not only used live steam (which was never put in for service only when there was no exhaust steam), but let the returns run to the sewer.

His successor is a young man full of enthusiasm, and with a good knowledge of his business. After examining the plant carefully he got into the boiler and found that near the back head the scale had filled in solid between the tubes. The engine cylinder had to be rebored and a new piston head put in. The valves were worn down fully ⅛ in. The ports were also rebored and new valves furnished.

The plant now uses more than a ton of coal per day less than formerly, and the management now sees that my successor would have been dear had he worked for nothing. Yet the management had been satisfied because it did not know any better and fully believed that as the plant was comparatively small, no skill was required to operate it. It should have hired an engineer when it wanted an engineer!

GEORGE H. WALLACE.

Racine, Wis.

Water Softeners

In the Jan. 9 issue, Mr. Hawkins inquires about water softeners. There are certain features and requirements which should be filled by every water-softening and purifying process. Briefly, these are as follows:

(1) The water should be examined and analyzed by a competent person to insure its accurate chemical treatment. (2) The final result must be perfect clarification. (3) The chemical reagents must be thoroughly and efficiently mixed with the water. (4) The chemical reactions must be complete. (5) They must also be as rapid as possible. (6) The sedimentation brought about by the action of the softening plant must also be rapid.

Any water which contains over 2 pints of total solid matter per 10,000 pints or over 1.75 pints of calcium or magnesium sulphate or carbonate, should, of course, be treated by some method of purification.

There are two methods of water purification, one in which the necessary amount of chemical ingredients is added to the water in one or more large, intermittently used tanks, one feeding while the water in the other is being treated. The other method is that in which the mixing is automatically accomplished.

Constant and intelligent supervision is essential to the successful application of either method, however. The operator should make sure, by daily tests, that the plant is working satisfactorily and sufficient time is allowed for the proper performance of the chemical reactions or else there will be much waste.

There are three undesirable kinds of impurities in boiler-feed water which cause scaling, corrosion and oil deposits. Scaling may be partly avoided by preheating the feed water, but the substances

producing the hardest scale, namely magnesium and calcium sulphates and carbonates, require chemical treatment for their removal.

The treatment of water containing corrosives usually involves the use of caustic soda, the effect of which is to neutralize the acid content of the water and to leave it slightly alkaline. Gaseous impurities causing corrosion—usually either chlorine, carbon dioxide or oxygen—may be got rid of by heating the feed water up to about 200 deg. F.

Filtration is the only satisfactory method of dealing with oily impurities. If the oil is emulsified with the water to such an extent that filtration alone will not separate them, it is advisable to use this method as a preliminary to the after treatment. The latter may undertake the removal of the oil by coagulation and precipitation or by electrical treatment. The general run of oil-separating devices is, however, rather unreliable and the effluent therefrom should be tested for purity every day.

In order of importance, the foregoing classes of impurities should read: oil, corrosives, scalers. The first two are dangerous, while scale only reduces the efficiency and not the life of the boiler.

JOHN S. LEESE.

Manchester, England.

Sand for Hot Boxes

The articles appearing in POWER under this heading have led to considerable verbal discussion in England, and for the most part the suggestion of using sand for hot boxes appears to be a huge joke. However, during my experience of many years as a seagoing engineer, I have myself adopted the sand treatment, as a last resort in difficult cases, with complete success.

British marine engineers do not include sand in their list of stores, but for scouring bright work they use a mixture of sand and silt, found in the bed of a tidal river in Somersetshire, known as bathbrick.

Many years ago, when I was a junior engineer on the Warren Line steamers, sailing between Boston, Mass., and Liverpool, we had on one voyage considerable trouble with a main bearing, 14 in. in diameter, which persisted in running hot in spite of all attempts to keep it cool. We had tried all the time-worn methods of slacking back the cap and drenching the bearing alternately with graphite, white lead and sulphur, mixed with oil in each case, and even the ship doctor's available supply of castor oil was poured in, but without success. All this was done under the supervision of the second engineer, who naturally thought himself able to overcome a hot bearing without the chief's assistance.

Apparently, the chief suspected something wrong—he probably smelt it—for he came down into the engine room to find the writer holding a hose over the bearing while three other engineers stood by and told one another in poetic language what they thought about it.

When informed that the bearing simply would not run cool, he told one of the juniors to scrape a handful of bathbrick into a pint of oil and pour it into the bearing through the handhole in the cap. Although we had the greatest respect for our chief's ability as an engineer, it seemed to us that he had suddenly developed a kink in his brain, but we were there to carry out his orders and we did as we were told, the second engineer in the meantime standing by the throttle, ready to slow down when the sand got a grip on the journal and began to pull up the engines.

The mixture of sand and oil was poured into the bearing slowly, being stirred constantly to prevent the sand from settling, and when it was all in, the bearing was allowed to run for about a minute; then about half a gallon of kerosene was run through to wash it out thoroughly, and finally the bearing was well oiled in the usual manner. The whole performance did not cover five minutes, after which the chief left us without waiting for results. The bearing did not trouble us any more, and when it was opened in port everything was clean, unscored and in perfect order. Many years afterward, as chief of a Mediterranean trader, I plucked up courage to try the same cure on an obstreperous main bearing 9½ in. in diameter, with equal success.

Now for the other side of the picture. Shortly after, I met in Genoa an old shipmate who was chief of another steamer, and in the course of conversation the subject of hot bearings was broached and I spoke of my experience with the sand remedy. Like most people, he was skeptical, and said so, but when I explained my theory he recovered sufficiently to admit that there might be something in it. We were sailing next day, both bound for Odessa, and, of course, we made a small bet on who would get there first. We lost sight of one another soon after sailing, and when my ship arrived at Odessa I was mildly pleased to find that my friend had not arrived.

His ship turned up two days later, and as soon as she was made fast he came to me with blood in his eye. He had applied the sand remedy to a hot bearing exactly as I had prescribed, and as a consequence was obliged to put into Constantinople to take out the bearings and file and scrape them into working order before they could proceed. He flatly accused me of playing a low-down trick on him in order to win the bet, which he declared to be off on a foul.

I went aboard his ship and had a look at the bearing, which bore undoubted signs of ill treatment, and as I puzzled over the problem, the truth came to me. In each case where I had used sand the bearings were of gunmetal, but in this instance the bearings were lined with white metal, so that when the sand had been put in it had become embedded in the soft metal and stayed there to scratch the journal.

It is obvious, then, that while sand can be applied with success in some cases, in others it would ruin a bearing under similar conditions.

The term "sand" suggests a hard, gritty abrasive, and this probably accounts for the derision with which the idea has been received in some quarters, but there are plenty of fine sands, similar to that to which I have referred, which, when mixed with oil or water, are easily ground to a soft mud under pressure between two metallic surfaces.

I quite agree with the theory that the cooling is due to the roughened surfaces allowing the oil to have access to the wearing parts in a manner that would be impossible with smooth or highly polished surfaces, but I also go farther and suggest that the effect is chiefly due to the fact that the sand rubs down the high spots that are the primary cause of the trouble. The amount rubbed off, however small, is sufficient to ease the load and distribute it among the other bearing points in the same line.

Whether either of these theories is right or wrong has yet to be proved, but the fact remains that sand is good for cooling hot bearings—provided one has the right kind of sand and a suitable bearing.

S. JONES.

London, Eng.

Why Not Glass for Hot Boxes?

When I read the first account of using sand in a hot bearing, I thought the writer must have lots of sand to publish the fact. I believe in the adage, "Where there is smoke there must be fire," and after reading more articles I became less skeptical; at the present time I would like to see it tried out.

As I understand the matter, it is a question of being able to get rid of all the sand after the operation. Very finely ground glass is now used for grinding in gas-engine valves. This has superseded emery because it does not tend to bed itself into the metal like the latter. If this is the case, why would it not be a good substitute for the grit we have read so much about people using which varied all the way from gravel to brick-dust?

I would like to hear from anyone who tries this method out.

JOHN BAILEY.

Milwaukee, Wis.

Inquiries of General Interest

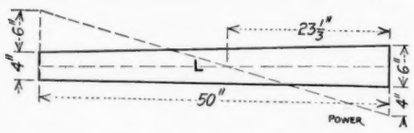
Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Center of Gravity

Where is the center of gravity of a trapezoid 50 in. long at the base, 6 in. high at one end and 4 in. high at the other?

G. G.

Referring to the illustration, the line *L* joining the middles of the altitudes is a line of gravity and is divided in such a ratio by the center of gravity that the following construction for finding the latter holds good. Prolong each altitude in opposite directions an amount equal



CENTER OF GRAVITY OF A TRAPEZOID

to the other altitude; join the two points thus found; the intersection with the other line of gravity is the center of gravity.

Another rule to obtain the center of gravity is:

Measure along the line of gravity from the higher altitude a distance equal to one-third the length of the base multiplied by the sum of the high altitude and two times the low altitude and divided by the sum of the high and the low altitudes.

Substituting figures for the rule, it would be expressed thus:

$$\frac{50}{3} \times \frac{6 + (2 \times 4)}{6 + 4} = \frac{50}{3} \times \frac{14}{10} = \frac{70}{3} = 23\tfrac{1}{3} \text{ in.}$$

Refrigerating Capacity of an Ammonia Compressor

What is the refrigerating capacity of a double-acting 12⅛x25¼-in. ammonia compressor, speed 60 r.p.m., in tons per 24 hours, if the back pressure is 30 lb., the head pressure 150 lb., the average temperature of the cooling water, 86 deg. F. and the temperature to be maintained in the brine tank is 17 deg. F.?

K. J. E.

To determine the refrigerating capacity of an ammonia compressor, divide the product of its cubic capacity and its volumetric efficiency by the number of cubic feet of gas per minute required at the temperature and pressure of expansion, and the temperature and pressure of liquefaction of the gas.

The capacity in cubic feet per minute of this compressor may be determined by multiplying the area of the cylinder by twice the length of stroke and by the number of revolutions per minute, and the product divided by 1728. Substituting figures for the rule, it would be expressed as follows:

$$\frac{(12.6875)^2 \times 0.7854 \times 21.25 \times 2 \times 60}{1728} = 186 \text{ cu.ft.}$$

To produce one ton of refrigeration per 24 hours at 150 lb. head pressure with cooling water at 86 deg. F. and 30 lb. back pressure and 17 deg. F. temperature of expansion, 2.615 cu.ft. of gas pumped per minute would be required of the compressor. For other pressures and temperatures more or less gas would be required, according to circumstances. This can be found in a table showing the refrigerating effect of ammonia at different pressures and temperatures, in any of the better class of engineers' handbooks. Assuming the volumetric efficiency of the compressor to be 80 per cent.

$$\frac{0.80 \times 186}{2.615} = 56.8 \text{ tons}$$

per 24 hours would be the capacity of the compressor.

Elevation of Boiling Point

Can the temperature of the boiling point of water at a given pressure be raised?

G. P.

Substances held in solution by water will raise its boiling point. A saturated solution of salt will boil at 214 deg. F.; and a saturated solution of calcium chloride at 370 deg. at atmospheric pressure. The boiling point of pure water free from gases may be as high as 260 deg. F.

Heat Units per Ampere

How much heat is developed in a wire per ampere of current?

R. W. O.

The heat units developed per second are proportional to the watts passed through the wire. The rise in temperature is proportional to the watts divided by the effective radiating surface. One watt is equal to 1.35625 ft.-lb. per second, and 778 heat units equal 1 ft.-lb.; therefore

$1.35625 \times 778 = 1055.1625$ *heat units* per second will be developed when one watt or one ampere at a pressure of one volt will be applied to the circuit.

Size of Generator for an Engine

What size generator could be operated by a 50-hp. engine, and how many 16-cp. lights would the generator supply?

C. L. R.

Assuming the overall efficiency of the engine and dynamo to be 85 per cent., this engine would produce at the dynamo terminals

$$50 \times 0.85 = 42.5 \text{ hp.}$$

One electrical horsepower equals 746 watts; therefore this engine would be capable of driving a generator producing

$$42.5 \times 746 = 31{,}705 \text{ watts}$$

or 31.7 kw. The nearest standard size generator would be 30 kw., or 30,000 watts. A 16-cp. carbon-filament lamp requires 56 watts, and a tungsten-filament lamp requires 20 watts. The generator would furnish current for

$$\frac{30{,}000}{56} = 536 \text{ carbon-filament lamps}$$

or

$$\frac{30{,}000}{20} = 1500 \text{ tungsten-filament lamps}$$

Heat Values

What are the relative heat values of gasoline, kerosene and ordinary illuminating gas as used in internal-combustion engines?

S. E. M.

Ordinary commercial gasoline contains about 18,000 B.t.u. per pound. Petroleum of a specific gravity of 0.87, has 18,000 B.t.u. per pound. Kerosene of a specific gravity of 0.8 has a value of 19,000 to 20,000 B.t.u. per pound. The heat value of illuminating gas varies greatly with the character of the gas, ranging from 500 to 700 heat units per cubic foot.

Absolute Zero

What is the temperature of absolute zero, and how is it determined?

G. A. Q.

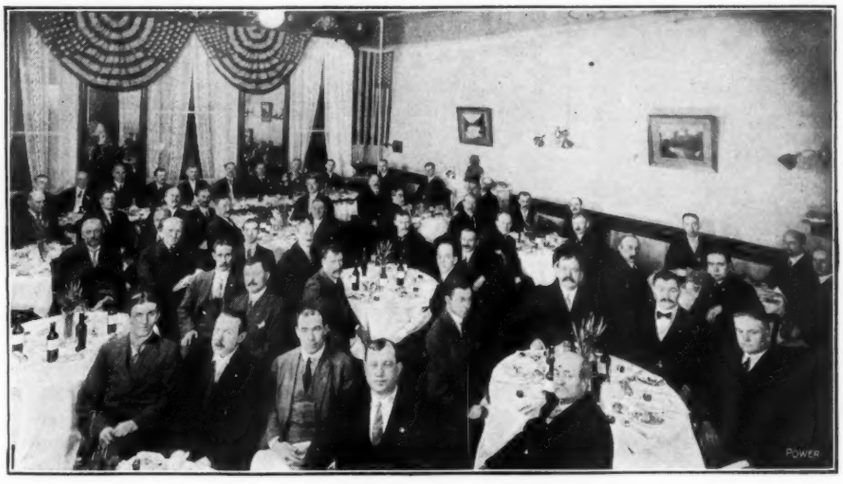
The expansion of a perfect gas under constant pressure is about $\frac{1}{492}$ of its volume at 32 deg. F. If the gas were cooled down to 492 deg. below freezing, or 460 deg. below zero, its volume would in all probability become zero. Various values are given by different authorities. That adopted by Marks and Davis in their steam tables as representing the greatest degree of accuracy attained is 459.64.

Annual Dinner of New York Steam Boiler Inspectors

The American Institute of Steam Boiler Inspectors of New York City held its second annual dinner at the Broadway Central Hotel, on Wednesday evening, Feb. 21, President T. T. Parker presiding.

Among the guests was Joseph H. McNeill, chief inspector of boilers for Massachusetts, who, by special permission of Governor Eugene N. Foss, addressed the guests on "The Advancement and General Adoption of the Massachusetts Boiler Laws in the United States and the Philippine Islands."

Mr. McNeill told of a new book which the department will shortly issue giving the details of all the ordinary sorts of riveted joints. He said that the usual attempts were being made to amend the law. One of these, that requiring all boilers to be inspected by the state whether insured or not, the department was opposing, but it was urging an amendment authorizing a state inspector to shut down any boiler which he found in a dangerous condition regardless of insurance. Mr. McNeill related an instance where a boiler was found running with the safety valve removed and the opening plugged.



NEW YORK BOILER INSPECTORS AT ANNUAL BANQUET

Brief speeches were made by other guests and members of the institute, and letters of regret were read from Col. Meier, of the Heine Boiler Co., Inspector-General George Uhler, of the government steamboat service, and Chief Inspector Wirmel, of Ohio.

An election was held resulting in the choice of the following officers for the ensuing year: President, J. M. Winter; vice-president, J. G. Shaw; secretary, R. A. Thomson, Travelers Insurance Co., 1 Madison Ave.; treasurer, James White; executive committee, Charles H. McAleenan, chairman; F. C. Williams, J. G. Gillespie, L. A. Turnbull, A. J. Lappan.

Retiring President Parker was presented a handsome gold watch.

New Orleans Convention of American Boiler Manufacturers' Association

A round-trip rate of $56.30 has been established from New York to New Orleans for the twenty-fourth annual convention of the American Boiler Manufacturers' Association and the Supplymen's Association at New Orleans, Mar. 12 to 15.

This rate entitles the holder to stop off at all the principal points along the line, and is good going and returning, until May 31, 1912. The Southern Ry. Co. is offering through-train service between New York and New Orleans, solid Pullman trains with drawing-room, compartment, sleeping, dining and observation cars.

It is advisable to secure Pullman accommodations at once. Also advise F. B. Slocum, secretary, Supplymen's Association, West and Calyer Sts., Brooklyn, N. Y., as to the time of arrival in New Orleans.

Fiftieth Birthday of Lunkenheimer Co.

The Lunkenheimer Co., of Cincinnati, Ohio, in honor of its fiftieth anniversary, tendered its employees and families an elaborate entertainment and dance, Saturday evening, Feb. 17, at the Armory, and over 4000 people attended. Provision was made for the entertainment of the employees' children, who were present in large numbers, and refreshments were served in great abundance.

Some conception of the growth of the Lunkenheimer Co. in less than a life time may be had when consideration is given the fact that in 1862, when the late Frederick Lunkenheimer laid its foundation, it had a small, one-man shop. He created a demand for his products that soon necessitated larger shops and more men, and this increase has continued until today the company occupies factories covering acres of ground and in which are employed 1500 men.

Swedish Engineers Honor Ericsson's Memory

The American Society of Swedish Engineers celebrated, on Feb. 17, at its home, 271 Hicks St., Brooklyn, N. Y., in connection with its annual dinner, the fiftieth anniversary of the "Monitor" and "Merrimac" battle, and paid tribute to the memory of Capt. John Ericsson, the inventor of the "Monitor."

Among the speakers were the Swedish consul, Magnus Clarholm; Erik Oberg, associate editor of *Machinery*, and W. Apel Warn, of the New York *Times*.

Civil Service Examinations

United States civil-service examinations will be held on Mar. 13 for a junior mechanical engineer for the Bureau of Mines, and on Apr. 10 for a cadet engineer in the lighthouse service, an engineer in the inland service and a junior engineer—mechanical or electrical—in the engineering department at large. Application forms and full information may be obtained by addressing the United States Civil Service Commission, Washington, D. C.

OBITUARY

Louis Delaunay-Belleville, the celebrated French engineer, died at Cannes, France, on Feb. 10. He was well known as the inventor and manufacturer of the Belleville boiler. Born in 1843, M. Delaunay-Belleville studied at the Ecole Polytechnique and the Ecole Navale, and in 1867 entered the Belleville engineering works. The works had established a reputation for the excellence of their boilers, but Delaunay-Belleville, by his talent and energy, gave an added impetus to the business and rose rapidly to be head of the firm. He enjoyed wide respect and esteem in commercial and engineering fields, and was an associate member of the British Institution of Naval Architects.

PERSONAL

G. J. Wells and A. J. Wallis-Tayler have formed a partnership under the title Wells & Tayler, as consulting engineers at 78 Fleet St., London, England. Mr. Wells has held positions on the staffs of the British Westinghouse Co. and other well known firms. Mr. Tayler has for some years had charge of extensive sugar estates and mines abroad and has also had considerable experience in refrigeration and cold storage. He is known in this country through his works on refrigeration.

Moments with the Ad. Editor

You remember that in the issues of January 23 and February 6 we asked these questions:

1. Which ad in this week's Selling Section of POWER, describing a product you have not been previously interested in and so far as you know have no present need for, gives you the strongest impulse to investigate it immediately? Why?

2. Which ad in this week's Selling Section seems to you to have the biggest "storing-up" value—as described above? Why?

3. Which ad seems to you THE BEST, in every way? Why?

4. Does any ad seem to you open to improvement? If so, how?

5. Which ads did you answer?

The answers have been surprisingly good and unusually interesting.

It is gratifying to note the interest manifested by POWER subscribers in the subject of advertising and particularly POWER advertising.

Like most questions on subjects which are not mathematically scientific, they provoke widely different opinions.

They are individual opinions, yet, taken as a whole, there is a consensus of opinion favoring certain kinds of advertisements which well informed advertising men know are the most productive.

In all questions pertaining to the worth of certain ads the critic is led in his selection by the *product* in which he is most interested. It influences his decision somewhat.

Question four, which asks for expressions as to which ads are open for improvement brought out some good *constructive* criticism. These opinions will be forwarded to the advertisers, but will not be printed here for the very good reason that it would be obviously unfair to the advertisers. They are *manufacturers* and do not pose as advertising *experts*.

Those letters which seem to be the best fitted to teach a lesson to readers or advertisers will be published from week to week. The ad editor may have something to say about each letter—a little friendly talk from *his* point of view.

In many cases the writers have asked that their names be withheld and this will be done in every case.

Number one is from the chief engineer of a large concern in Winsted, Conn., and just because he says we "dassent," we will let it see the light of printers' ink—and see it first.

In your editorial of Jan. 23, you ask for our opinion on several very delicate questions, some of which require the engineer to be a diplomat in the art of telling a man that his child is all right, but— Now, you see, we are dealing with the most of these good fellows, as well as you who have a mission to fulfill with an object which is honorable and ambitious on your part. The advertising business undoubtedly lies very close to your heart. Therefore I make a guess that none of our views ever see daylight in printers' ink, but for what good my individual opinion will be, you are welcome to it.

In looking over the ads of this week, I find one from the American District Steam Co., of North Tonawanda, N. Y., advising investigation into the problem of using surplus exhaust steam for heating neighboring buildings. I am not in a position at present, or do I know when the time will be opportune for such a proposition, but I know that my environments are ideal, and all data on the subject will some day be of great value, so they got an inquiry from me on this subject.

The ad that in my opinion has the biggest educative value is the Simplex Seatless Blow-Off Valves of Yarnall-Waring Co., of Philadelphia, Penn., on page 77, notwithstanding that the Nelson Valve Company has a full page ad on the same subject, and practically the same article; but the question is, why was my attention called to the Simplex with half the space? My opinion is that it was the cut of the valve taking up most of the space, and being very explicit in detail. Then it may be because the Nelson ad came afterward that my interest and inquiry were obtained in this instance, but the Nelson Valve Co. will, later on, receive a letter from the firm asking for information on the subject.

The ad that I consider par excellence, is the American Steam Gauge and Valve Mfg. Co., of Boston, Mass., on pages 54 and 55 of Jan. 23, 1912, issue.

Its prominence in position and space, its make up of bold face type treating intelligently and concisely each subject they wish to bring before the reader are good. The initiative place in the department of business is a factor, for the saying that there is a place for everything and everything in its place holds good, especially in advertising. It is my opinion that such matter placed in the first pages or on the covers of any publication receives secondary consideration from those regularly classified.

This ad as I open the doors of business, strikes me like meeting one of the firm in the engine room with hand extended, with the cheerful greeting of, "Well, my boy, how is this old world using you?" Although I have to say in the end that there is nothing in his line that I am in need of at present.

The ads I answered this week are: Schaeffer & Budenberg, and Schuchardt & Schutte, tachometers; the American District Steam Co., bulletin; Yarnall-Waring Co., valves.

There you are, chief. Your letter is in printers' ink and it deserves to be because you've put the matter well.

Next week one or more additional letters will be published and these show other angles of the question.

NEW EQUIPMENT

ATLANTIC COAST STATES

Fire recently destroyed the electric generator house of the Monadnock Mills, Claremont, N. H.

The Gardner Electric Co. is considering the construction of a transforming station, at Hubbardston, Mass. E. J. Richards, Fitchburg, is manager.

The Hooker Electro-Chemical Co. will build an addition to its plant, at Niagara Falls, N. Y.

An abbattoir, to cost $150,000, will be constructed, at First Ave. and Forty-third St., New York, N. Y., by G. A. Harrington, 2170 Broadway, New York.

Bids will be received by Charles B. Stover, president of the park board, Arsenal Building, Fifth Ave. and Sixty-fourth St., New York, N. Y., until 3 p.m., Mar. 14, for the construction and completion of a boiler house for the Metropolitan Museum of Art, Fifth Ave. and Eighty-third St.

Bids will be received by the director of public safety, city hall, Cincinnati, Ohio, until noon, Mar. 4, for equipment for the combined municipal water and lighting plant for the village of Carthage, Ohio. Bids to be submitted under two items, as follows: Item 1: Boilers, engines, electric generators, water-works pumping machinery and miscellaneous station equipment. Item 2: Poles, lines and service equipment.

Big Flats, N. Y., is considering the installation of a street lighting system.

The Endicott Light, Heat & Power Co., Endicott, N. Y., will soon start the construction of an electric-light plant.

The Pennsylvania R.R. Co. is contemplating the construction of a new power house, at Pitcairn, Penn. A. W. Gibbs, Philadelphia, Penn., is chief mechanical engineer.

The Lehigh Valley R.R. Co. will build an electric-power plant, at Hauto, Penn. Estimated cost, $2,000,000. A. L. Roberts, South Bethlehem, Penn., is mechanical engineer.

Sharon, Penn., is considering the installation of a municipal electric-light plant.

The Hagerstown Ry. Co. will build an electric-power plant on the Antietam Creek, at Security, Md. Estimated cost, $250,000. D. C. Haldeman, Hagerstown, Md, is general manager.

SOUTHERN STATES

The Gadsden Car Works, Gadsden, Ala., contemplates the installation of an electric-light plant.

The Hattiesburg Traction Co., Hattiesburg, Miss., is planning extensive improvements to its power plant. C. Z. Stevens is general manager.

The United Fruit Co., 131 State St., Boston, Mass., will erect a 300-ton ice plant, at New Orleans, La., to cost about $250,000. C. H. Ellis, New Orleans, is manager.

Bids will be received by N. C. Ridgway, mayor, Falmouth, Ky., until 5 P. M., Mar. 11, for the installation of a small electric-light equipment, consisting of a 35 or 50 K. V. A. engine and generator, switchboard, piping, poles, lines, transformers, series street lights. Plans and specifications are on file at the office of Anderson & Frankel, Lexington, Ky.

Tompkinsville, Ky., is considering the installation of a municipal electric-light plant and street-lighting system.

CENTRAL STATES

The Western Ohio R.R. will expend about $50,000 on improvements to its power plant at St. Marys, Ohio. F. B. Mason, St. Marys, is chief engineer.

The Allyn Engineering Co. has prepared plans for a power plant to be built by the Alvey-Ferguson Co., at Oakley, Cincinnati, Ohio.

The Bailey Engineering Co., Alliance, Ohio, has prepared plans for the installation of a new electric-light plant at Salem, Ohio.

Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until 3 p.m., Mar. 15, for two engines and generators to be installed in the U. S. Custom House at Cincinnati, Ohio.

George Champe, Toledo, Ohio, is preparing plans for a new municipal electric-light plant at Clyde, Ohio.

The Factory Power Co., Oakley, Ohio, has increased its capital stock from $100,000 to $200,000. This company supplies power for commercial purposes and will enlarge its plant in the spring.

Shuler & Benninghofen, Hamilton, Ohio, will build a power plant in connection with their woolen felt manufacturing mill.

Bids will be received by the director of public safety, city hall, Cincinnati, Ohio, until noon, Mar. 4, for equipment for the combined municipal water and lighting plant for Madisonville, Ohio. Bids to be submitted under two items, as follows: Item 1: Boilers, engines, electric generators, water-works pumping machinery, 125,000-gal. elevated steel water tower, and miscellaneous station equipment. Item 2: Poles, lines and service equipment.

A new plant for the manufacture of artificial ice will be built by the Queen City Ice Delivery Co., at Carlisle and John Sts., Cincinnati, Ohio.

The Michigan Carbon Works, Detroit, Mich., are to erect a new power plant.

The Commonwealth Power Co. is considering several improvements to its plant at Allegan, Mich. W. P. Stevens, Kalamazoo, is local superintendent and chief engineer.

L. J. Highland will install an electric-light plant at Blandinsville, Ill., to furnish electricity for street lighting.

The Illinois Gasoline & Kerosene Engine Co., Chicago, Ill., has been incorporated, to manufacture engines and tools. The incorporators are L. C. Kuhnert, S. Adler and H. L. Weiss.

The engine and boiler houses of the Breese Coal & Mining Co., at Breese, Ill., were destroyed by fire, on Feb. 6.

The Columbia Shade Cloth Co., Peoria St., Chicago, Ill., will build a power house.

The Hygienic Ice Co. will build a two-story ice-manufacturing plant, at 6515-23 State St., Chicago, Ill.

C. F. Ringer & Son, Hathaway Building, Milwaukee, Wis., are preparing plans for a printery and bindery, to be erected by the Milwaukee Lithographing Co., at Clybourn and Twenty-second Sts., Milwaukee, Wis.

The Eastern Wisconsin Ry. & Light Co. will install a steam turbine and rotary converter in its power plant at Fond du Lac, Wis. J. P. Pulliam, Oshkosh, Wis., is general manager.

WEST OF THE MISSISSIPPI

Central City, Iowa, has voted bonds for the installation of a water-works system.

The Jefferson Electric Co., Jefferson, Iowa, is considering improvements to its plant, to cost approximately $20,000. Percy Gray is manager.

Bids will be received by the village council, Biwabik, Minn., until Mar. 9, for the installation of a street lighting system on Main St. J. E. Riley is village clerk.

Eldorado, Kan., is contemplating the construction of a municipal electric-light plant.

De Witt, Neb., is planning to install a municipal electric-light plant.

The Loup City Mill & Light Co., Loup City, Neb., will construct an electric-light plant on the Calamus River.

Kearney, Neb., has voted a bond issue of $40,000 for street-lighting purposes. The Oscar Claussen Engineering Co., Minneapolis, Minn., are the engineers in charge. George E. Ford is city engineer.

The electric plant of the Harrison Electric Light & Ice Co., Harrison, Ark., was recently wrecked, owing to a break in the piston rod of an engine. Loss, $25,000.

The Eastern Texas Traction Co. contemplates the construction of a new power house at Greenville, Tex. J. B. Murphy, Greenville, is general manager.

The Creamery Dairy Co., San Antonio, will build a 50-ton ice plant, at Yoakum, Tex.

Tucumcari, N. M., will enlarge the municipal electric-light and power plant.

C. C. Lewis, Carlsbad, N. M., is considering the enlargement of his ice plant and the erection of a cold-storage plant.

The American Sugar Refining Co., Elida, Ariz., is considering the construction of a sugar-refining plant, at Portales, Ariz. Estimated cost, $2,000,000.

Winlock, Wash., is considering the installation of a water-works system.

The Pacific Power & Light Co. will construct a pumping station, at Pasco, Wash. R. J. Andrus, Pasco., is local manager.

Henry Linster, Bend, Ore., has applied to the city council of Bend for a franchise for a water and electric system in Aubrey Heights, a suburb of Bend.

The Interior Electric Power Co., Pendleton, Ore., recently organized, will soon commence the erection of a power plant to furnish light and power to Pendleton and Milton, Ore.

Union, Ore., will expend $20,000 for extensions to its water-works system.

The United Water & Power Co., Gold Run, Calif., recently incorporated, plans for the erection of an electric-power plant, near Dutch Flat, Calif. James D. Stewart is manager.

F. W. Georgeson, mayor of Eureka, Calif., has recommended the construction of a municipal light, power and water plant. Estimated cost, $1,000,000.

Roseville, Calif., is contemplating the installation of a municipal electric-light plant. Estimated cost, $10,000. W. S. Marshalls, Sacramento, Calif., is engineer in charge.

Evans & Brooke, Sonoma, Calif., plan to increase the capacity of their plant and rebuild all their lines.

D. A. R. Sprague, Berkeley, Calif., contemplates the construction of an intermittent vacuum precooling plant, at New Orleans, La.

The Southern California Edison Co. will build a substation on Bonita Ave., Sierra Madre, Calif., to supply power to the Sierra Madre territory. R. H. Ballard, Los Angeles, is secretary and manager.

Plans are being prepared for the installation of an ornamental lighting system on Seventh St., between Hoover St. and the Los Angeles River, Los Angeles, Calif. Homer Hamlin is city engineer.

The Siskiyou Electric Power & Light Co. is contemplating the construction of a substation at Weed, Calif., to supply electricity to the Weed Lumber Co. J. W. Churchill, Yreka, Calif., is president and manager.

The plant of the Canadian Carbide Co., Merritton, Ont., will be enlarged.

The Goldie & McCulloch Co., Galt, Ont., will enlarge its boiler shop.

The city commissioners of Saskatoon, Sask., will receive bids until Mar. 8 for electrical machinery, including five 500-hp. water-tube boilers, five sets of automatic stokers, economizers for 2000-hp. capacity, two feed pumps, one 2000-kw. steam turbine, two 75-kw. turbine exciters, one generator panel and two exciter panels with necessary cables and apparatus.

NEW CATALOGS

McCord Mfg. Co., Detroit, Mich. Catalog. Force feed lubricators. Illustrated, 22 pages, 6x9 inches.

American Steam Truck Co., Lansing, Mich. Catalog. Heavy service trucks. Illustrated, 22 pages, 7x10 inches.

Seager Engine Works, Lansing, Mich. Catalog. Olds gas, gasoline, kerosene engines. Illustrated, 48 pages, 6x9 inches.

International Gas Engine Co., Cudahy, Wis. Gas, gasoline, oil and producer gas engines. Illustrated, 64 pages, 6x9 inches.

Albany Lubricating Co., 708-710 Washington St., New York. Booklet. "Death to Friction." Illustrated, 16 pages, 5x7 inches.

Automatic Engine Stop Co., Sheboygan, Wis. Booklet. "The Frictionless" automatic engine stop. Illustrated, 3½x6 inches.

The Cork Insert Co., 16 State St., Boston. Pamphlet. "Here's the Proof." Testimonial letters from users. 50 pages, 6x9 inches.

Macbeth-Evans Glass Co., Pittsburg, Penn. Bulletin. Ornamental Street Lighting and Alba Globes. Illustrated, 32 pages, 8½x11 inches.

The Westinghouse Elec. & Mfg. Co., Pittsburg, Penn. Leaflet No. 2298. Type CCL induction motor. Illustrated. Leaflet No. 2330. Type JL direct-current ammeters and voltmeters. Illustrated.

Harrison Safety Boiler Works, Philadelphia, Penn. Engineering Leaflet No. 12. "What Scale Does to Boilers and What Is Gained by Keeping It Out of Them." Illustrated, 40 pages, 6x9 inches.

The Industrial Instrument Co., Foxboro, Mass. Bulletin No. 58. Thermometers and thermographs for indicating and recording temperature. Illustrated, 24 pages, 8x11 inches. Bulletin No. 59. Recording liquid level gages. Illustrated, 12 pages, 8x11 inches.

ENGINEERS WANTED

Under this head are published, without charge, advertisements of actual vacancies in power plants for operating engineers and assistant engineers. For the guidance of applicants for advertised positions, the advertisements must contain particulars to show the class of service demanded and the wages paid. Employers who desire to advertise under this head are requested to write for a blank form of application.

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

SALESMAN — Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," Power.

AGENTS for first-class steam specialty in use throughout United States. Address C. S. Wood, 410 S. 15th St., Philadelphia, Penn.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesman Address G. L. Simonds & Co., 802 Steinway Bldg., Chicago, Ill.

ACTIVE AGENTS wanted to handle an engine room and water-works specialty of great merit; we will give exclusive territory; a well paying proposition for energetic man. Box 599, Power.

SALESMEN handling boiler supplies and accessories; write at once for new proposition; can handle with present line. Address "D. G.," 832 Monadnock Block, Chicago.

AGENTS WANTED to sell forced draft blowers and damper regulators; will give exclusive territory to right parties; commission on sales. Turbo-Blower Co., 30 Church St., New York.

MANUFACTURERS' AGENTS to handle thoroughly guaranteed steam specialties; feed water heaters, steam and oil separators, traps and exhaust pipe heads; not necessary to represent entire line if interested in only part of it; our specialties are well advertised and of good reputation. Box 569, Power.

FOUR FIRST-CLASS electric power salesmen in city of three hundred thousand population where there are many woodworking plants, textile mills, flour mills and steel rolling mills; could use also good man versed in refrigeration and ice making. Address "Power Business," 1720 Railway Exchange, Chicago, Ill.

SITUATIONS WANTED

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

ENGINEER wants position; at present employed; can come on week's notice. Box 600, Power.

SALES POSITION desired by engineer; 11 years' practical experience; power plant, refrigeration, electrical; good education, excellent references. Address Box 601, Power.

POSITION wanted by engineer; two years' experience with Corliss engines and general upkeep of boilers and accessories, using my own indicator; familiar with steam shovels; a wide experience with traction engines; references given. Box 603, Power.

ELECTRICAL and mechanical engineer, technical graduate, wishes position as superintendent of medium sized plant; experienced with steam, producer-gas and hydraulic plants; can handle operating and commercial end efficiently. Box 602, Power.

WANTED—A position with contracting firm or with a company as engineer by man of 20 years' experience; can do erecting and repair work in first-class manner; claims to be practical expert on engines, boilers and pumps. Box 598, Power.

ENGINEER or superintendent of small electric power plant; eight years' experience, producer gas, oil or steam; employed at present, but desire change; good reasons; married, sober and capable of rebuilding plant if necessary; state salary. Address Box 581, Power.

MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

NOTICE TO ELECTRICAL CONTRACTORS and Engineers—Sealed bids addressed to J. E. McClelland, chairman of the electric light committee, will be received at the office of the chief of construction, Atlanta, Ga., until 10 a.m., Friday, March 11, as to the cost of making an examination and report on the electric situation in Atlanta with a view to the construction of a municipal plant. Bidders will be expected to examine personally the ground and make a proposition to the city of Atlanta in a specified amount as to what their charge will be, and submit also a recommendation as to the location, taking into consideration both steam and water power.

After the engineer is selected, the engineer will be expected to formulate a report with a recommendation as to the location with a tentative plan and specifications showing the plant and an estimated cost of the same, this estimate to be made in detail, so that in considering the same, the city can arrive at a correct conclusion as to what the cost will be. The engineer will also be expected to make an estimate of the cost per kilowatt of furnishing the city of Atlanta with electricity, either for public or private use. The number of lamps in the city at present consists of 1520 arcs, 450 watts each; 950—75 c.p. lamps of 100 watts each, also 400 white way posts at five lights each of 80 c.p.

The amount of power now used in public buildings is not estimated, but the engineer, in making his estimate, will have to examine into this matter carefully, so that the plant as built will be able to furnish all the current needed for this purpose.

In addition to the above, estimates will also be submitted showing the cost for building a plant necessary for furnishing the citizens of Atlanta with power and light.

The engineer will be able to get any information now in the hands of either the chief of construction, city electrician or city attorney in order to enable him to arrive at correct conclusions. He will not be expected to make correct surveys, but can make his estimates from the maps that will be furnished, said maps to be on scale. In the fire limits of the city conduits will be required, but in all that portion of the city outside the fire limits the wires can be placed on overhead poles.

The present area of the city is approximately 26 square miles, with an estimated population of 160,000.

The right is reserved to reject any or all bids.

Bids must be submitted on the above items separately; first, on the cost of a municipal plant as above indicated, and, second, upon the cost of such municipal plant and a plant of sufficient capacity to furnish the citizens of Atlanta with electric power and light. J. E. McClelland, Chairman Electric Light Committee.

PATENTS SECURED—C. L. Parker, Patents, 904 G St., Washington, D. C.

PATENTS—Herbert Jenner, patent attorney and mechanical expert, 608 F St., Washington, D. C. I make a free search and report if patent can be had and the exact cost.

ENGINEERS AND FIREMEN—Send 10 cents in stamps for a 40-page pamphlet containing a list of questions asked by an examining board of engineers. Stromberg Publishing Co., 2703 Cass Avenue, St. Louis, Mo.

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. M. Y. C., 1417 W. Jackson Blvd., Chicago, Ill.

WANTED—An established concern to build and sell a new stoker, on a royalty basis; device is designed on scientifically correct principles for efficiency and smokelessness; good opportunity for some live concern. Box 595, Power.

WANTED to sell at $50,000; less than cost a new and newly equipped manufacturing plant on Pacific Coast, doing a good business; large acreage, upward of 20,000 ft. floor space, railroad spur on grounds, within six miles of tide water. Address Box 593, Power.

FOR SALE

Advertisements under this head are inserted for 25 cents per line. About five words make a line.

FIVE CORLISS vertical water leg, and sixteen Manning vertical type boilers. J. M. P. Coats, Ltd., Pawtucket, R. I.

LATEST MODEL heavy duty 18x42 Brown engine, installed 1904; for sale account of removal. Box 575 Power.

8x10 SKINNER ENGINE, direct connected to 30-kilowatt generator, and 8x10 Allfree engine, direct connected to 20-kilowatt generator . Address "Engineer," Box 2, Station A, Cincinnati, Ohio.

TWO 72x18-in. horizontal return-tubular boilers; two 66x20-in. horizontal return-tubular boilers; one stack, ⅜-in. steel, 28 in. diameter, 60 ft. long; the above boilers are now in use and can be seen by applying at office, Warren and Morris St., Jersey City, N. J.

TWO DICK & CHURCH automatic power engines, horizontal tandem compound, 250 hp. each, size 16¼ x30x18, with band wheels; both fine condition, good as new, installed 1907; price $800 each, f.o.b. cars; seen running until April 1 at Standard Oil Co., Bayonne, N. J. Address A. M. Stadler, 17 East 24th St., New York City.

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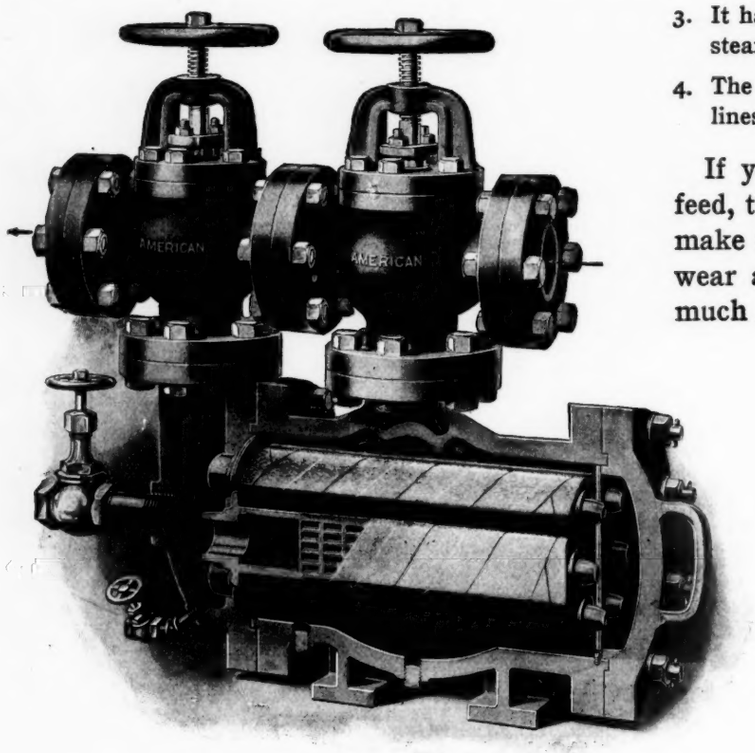

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